

## Chapter **3** Chemical Bonding

Atoms of different elements *excepting* noble gases donot have complete octet so they combine with other atoms to form chemical bond. *The force which holds the atoms or ions together within the molecule is called a chemical bond* and the process of their combination is called *Chemical Bonding*. It depends on the valency of atoms.

#### Cause and Modes of chemical combination

Chemical bonding takes place due to *acquire a state of minimum* energy and maximum stability and to convert atoms into molecule to acquire stable configuration of the nearest noble gas. We divide atoms into three classes,

(1) Electropositive elements which give up one or more electrons easily. They have low ionisation potentials.

(2) Electronegative elements, which can gain electrons. They have higher value of electronegativity.

(3) Elements which have little tendency to lose or gain electrons.

Different types of bonds are formed from these types of atoms.

Atoms involved	Туре
A + B	Electrovalent
<i>B</i> + <i>B</i>	Covalent
A + A	Metallic
Electrons deficient molecule or ion	Coordinate
(Lewis acid) and electrons rich	
molecule or ion (Lewis base)	
H and electronegative element (F,	Hydrogen

N,O)

#### Electrovalent bond

An electrovalent bond is formed when a metal atom transfers one or more electrons to a non-metal atom.



Some other examples are: *MgCl, CaCl, MgO, NaS, CaH, AlF, NaH, KH, K*<sub>2</sub>O, *KI, RbCl, NaBr, CaH* etc.

#### (1) Conditions for formation of electrovalent bond

(i) The atom which changes into cation (+ ive ion) should possess 1, 2 or 3 valency electrons. The other atom which changes into anion (-ve ion) should possess 5, 6 or 7 electrons in the valency shell.

(ii) A high difference of electronegativity (about 2) of the two atoms is necessary for the formation of an electrovalent bond. *Electrovalent bond is not possible between similar atoms.* 

(iii) There must be overall decrease in energy i.e., energy must be released. For this an atom should have low value of **lonisation potential** and the other atom should have high value of **electron affinity**.

(iv) Higher the lattice energy, greater will be the case of forming an ionic compound. The amount of energy released when free ions combine together to

form one mole of a crystal is called **lattice energy** (U). Lattice energy =  $\frac{\kappa}{r^+ + r^-}$ ;

 $r^+ + r^-$  is internuclear distance.

The energy changes involved in the formation of ionic compounds from their constituent elements can be studied with the help of a thermochemical cycle called **Born Haber cycle**.

$$Na(s) + \frac{1}{2}Cl_{2}(g) \longrightarrow \Delta H_{f}$$

$$\Delta H_{sub} \longrightarrow 1/2\Delta H_{diss.} \longrightarrow \Delta H_{f}$$

$$Na(g) + Cl'(g) \longrightarrow NaCl'(s)$$

$$+lE \longrightarrow -e^{-} - EA \longrightarrow +e^{-} - U$$

$$Na^{+}(g) + Cl^{-}(g) \longrightarrow (Lattice energy)$$

$$(Born Haber Cycle)$$

According to Hess's law of constant heat summation, heat of formation of an ionic solid is net resultant of the above changes.

$$\Delta H_f = \Delta H_{\text{Subl.}} + \frac{1}{2} \Delta H_{\text{diss.}} + IE - EA - U$$

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#### (2) Characteristics of electrovalent compounds

(i) Electrovalent compounds are generally crystalline is nature. The constituent ions are arranged in a regular way in their lattice.

 (ii) Electrovalent compounds possess high melting and boiling points. Order of melting and boiling points in halides of sodium and oxides of ll<sup>-</sup> group elements is as,

NaF > NaCl > NaBr > NaI, MgO > CaO > BaO

(iii) Electrovalent compounds are hard and brittle in nature.

 $({\rm iv})$  Electrovalent solids do not conduct electricity. While electrovalent compounds in the molten state or in solution conduct electricity.

 $\left(v\right)$  Electrovalent compounds are fairly soluble in polar solvents and insoluble in non-polar solvents.

 $({\rm vi})$  The electrovalent bonds are non-rigid and non-directional. Thus these compound do not show space isomerism e.g. geometrical or optical isomerism.

(vii) Electrovalent compounds furnish ions in solution. *The chemical reaction of these compounds are known as ionic reactions, which are fast,* 

$$K^+Cl^- + \stackrel{+}{Ag} \stackrel{-}{NO}_3 \longrightarrow \stackrel{+}{Ag} \stackrel{-}{Cl} \downarrow + \stackrel{+}{K} \stackrel{-}{NO}_3$$

(viii) Electrovalent compounds show isomorphism.

 $({\rm ix})$  Cooling curve of an ionic compound is not smooth, it has two break points corresponding to time of solidification.

 $\left(x\right)$  lonic compounds show variable electrovalency due to unstability of core and inert pair effect.

#### Covalent bond

Covalent bond was first proposed by **Lewis** in 1916. *The bond formed between the two atoms by mutual sharing of electrons so as to complete their octets or duplets (in case of elements having only one shell) is called covalent bond or covalent linkage.* A covalent bond between two similar atoms is non-polar covalent bond while it is polar between two different atom having different electronegativities. Covalent bond may be single, double or a triple bond. We explain covalent bond formation by Lewis octet rule.

Chlorine atom has seven electrons in the valency shell. In the formation of chlorine molecule, each chlorine atom contributes one electron and the pair of electrons is shared between two atoms. both the atoms acquire stable configuration of argon.

$$Cl \bullet *Cl_{*}^{**} \rightarrow \underbrace{Cl}_{(2,8,7)}^{*} (2,8,7) \xrightarrow{(2,8,7)} (2,8,7)} (2,8,7) \xrightarrow{(2,8,8)} (2,8,8) \xrightarrow{(2,8,8)} (2,8,8)$$

Some other examples are  $H_2S$ ,  $NH_3$ , HCN,  $PCl_3$ ,  $PH_3$ ,

 $C_2H_2, H_2, C_2H_4, SnCl_4, FeCl_3, BH_3$ , graphite,  $BeCl_2$  etc.

#### (1) Conditions for formation of covalent bond

(i) The combining atoms should be short by 1, 2 or 3 electrons in the valency shell in comparison to stable noble gas configuration.

(ii) Electronegativity difference between the two atoms should be zero or very small.

(iii) The approach of the atoms towards one another should be accompanied by decrease of energy.

#### (2) Characteristics of covalent compounds

(i) These exist as gases or liquids under the normal conditions of temperature and pressure. Some covalent compounds exist as soft solids.

(ii) Diamond, Carborandum (*SiC*), Silica (*SiO*), *AlN* etc. have giant three dimensional network structures; therefore have exceptionally high melting points otherwise these compounds have relatively low melting and boiling points.

(iii) In general covalent substances are bad conductor of electricity. Polar covalent compounds like *HCl* in solution conduct electricity. Graphite can conduct electricity in solid state since electrons can pass from one layer to the other.

(iv) These compounds are generally insoluble in polar solvent like water but soluble in non-polar solvents like benzene etc. some covalent compounds like alcohol, dissolve in water due to hydrogen bonding.

(v) The covalent bond is rigid and directional. These compounds, thus show isomerism (structural and space).

(vi) Covalent substances show molecular reactions. The reaction rates are usually low.

(vii) The number of electrons contributed by an atom of the element for sharing with other atoms is called covalency of the element. Covalency = 8 – [Number of the group to which element belongs]. The variable covalency of an element is equal to the total number of unpaired electrons in s, p and d-orbitals of its valency shell.

The element such as *P*, *S*, *Cl*, *Br*, *I* have vacant *d*-orbitals in their valency shell. These elements show variable covalency by increasing the number of unpaired electrons under excited conditions. The electrons from paired orbitals get excited to vacant *d*-orbitals of the same shell.

Four elements, H, N, O and F do not possess d-orbitals in their valency shell. Thus, such an excitation is not possible and variable valency is not shown by these elements. This is reason that NCl exists while NCl does not.

(3) **The Lewis theory** : The tendency of atoms to achieve eight electrons in their outermost shell is known as lewis octet rule.

Lewis symbol for the representative elements are given in the following table,

Lewis symbol	<b>χ</b> •	• <i>x</i> •	• <i>X</i> •	• <i>X</i> •	• <i>X</i> •	• X •	X
Group	IA	- 11A	IIIA	IVA	VA	VIA	VIIA
	1	2	13	14	15	16	17

(4) **Failure of octet rule :** There are several stable molecules known in which the octet rule is violated *i.e.*, atoms in these molecules have number of electrons in the valency shell either short of octet or more than octet.

 $BeF_2, BF_3, AlH_3\,$  are electron- deficients (Octet incomplete) hence are Lewis acid.

In  $PCl_5$ , P has 10 electrons in valency shell while in  $SF_6$ , S has 12 electrons in valence shell. **Sugden** introduced singlet linkage in which one electron is donated (Instead of one pair of electrons) to the electron deficient atom so that octet rule is not violated. This singlet is represented as (-). Thus,  $PCl_5$  and  $SF_6$  have structures as,

$$\begin{array}{ccc} Cl & Cl & F & F \\ & & & & \\ Cl - P - Cl & F - S - F \\ & & & & \\ Cl & & & F \end{array}$$

(5) **Construction of structures for molecules and poly atomic ions :** The following method is applicable to species in which the octet rule is not violated.

(i) Determine the total number of valence electrons in all the atoms present, including the net charge on the species (n).

(ii) Determine  $n = [2 \times (number of H atoms) + 8 \times (number of other atoms)].$ 

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(iii) Determine the number of bonding electrons, *n*, which equals *n* -n. No. of bonds equals n/2.

(iv) Determine the number of non-bonding electrons, *n*, which equals n - n. No. of lone pairs equals n/2.

(v) Knowing the central atom (you'll need to know some chemistry here, math will not help!), arrange and distribute other atoms and n/2bonds. Then complete octets using n/2 lone pairs.

(vi) Determine the 'formal charge' on each atom.

(vii) Formal Charge = [valence electrons in atom) - (no. of bonds) -(no. of unshared electrons)]

(viii) Other aspects like resonance etc. can now be incorporated.

#### Illustrative examples

(i)  $CO_3^{2-}$ ;  $n_1 = 4 + (6 \times 3) + 2 = 24$  [2 added for net charge]

 $n_2 = (2 \times 0) + (8 \times 4) = 32$  (no. *H* atom, 4 other atoms (1'*C* and 3)  $(\mathcal{O})$ 

 $n_3 = 32 - 24 = 8$ , hence 8/2 = 4 bonds

 $n_4 = 24 - 8 = 16$ , hence 8 lone pairs.

Since carbon is the central atom, 3 oxygen atoms are to be arranged around it, thus,

$$0$$
  
 $-C - 0$  but tota

O , but total bonds are equal to 4. 0

nce, we get 
$$\left. O - \stackrel{|}{C} = O 
ight.$$
 Now, arrange lone pairs to complete

octet : 
$$O - C = O$$
 :

 $\vec{0}$ 

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(ii)  $CO_2$ ;  $n = 4 + (6 \times 2) = 16$ 

 $n = (2 \times 0) + (8 \times 3) = 24$ 

n = 24 - 16 = 8, hence 4 bonds

n = 16 - 8 = 8, hence 4 lone-pairs

Since C is the central atom, the two oxygen atoms are around to be arranged it thus the structure would be; O - C - O, but total no. of bonds = 4

Thus, O = C = O. After arrangement of lone pairs to complete

octets, we get, : 
$$O = C = O$$
 : and thus final structure is :  $O = C = O$  :

#### Co-ordinate covalent or Dative bond

This is a special type of covalent bond where the shared pair of electrons are contributed by one species only but shared by both. The atom which contributes the electrons is called the donor (Lewis base) while the other which only shares the electron pair is known as **acceptor** (Lewis acid). This bond is usually represented by an arrow  $(\rightarrow)$  pointing from donor to the acceptor atom.

BF molecule, boron is short of two electrons. So to complete its octet, it shares the lone pair of nitrogen in ammonia forming a dative bond.



Examples : CO, NO, HO, NO, NO, NO, HNO, NO<sub>3</sub>, SO, SO,

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 $H_{3}PO_{4}, H_{4}P_{2}O_{7},$ 

 $H_3PO_3$ ,  $Al_2Cl_6$ (Anhydrous)  $O_3$ ,  $SO_2Cl_2$ ,  $SOCl_2$ ,  $HIO_3$ ,  $HClO_4$ ,

 $HClO_3, CH_3NC, N_2H_5^+, CH_3NO_2, NH_4^+, [Cu(NH_3)_4]^{2+}$  etc.

#### Characteristics of co-ordinate covalent compound

 $SO_4^{2-}, SO_2^{2-},$ 

(1) Their melting and boiling points are higher than purely covalent compounds and lower than purely ionic compounds.

(2) These are sparingly soluble in polar solvent like water but readily soluble in non-polar solvents.

(3) Like covalent compounds, these are also bad conductors of electricity. Their solutions or fused masses do not allow the passage to electricity.

(4) The bond is rigid and directional. Thus, coordinate compounds show isomerism.

## **Dipole moment**

"The product of magnitude of negative or positive charge (q) and the distance (d) between the centres of positive and negative charges is called dipole moment".

 $\mu$  = Electric charge × bond length

As q is in the order of 10° esu and d is in the order of 10° cm,  $\mu$  is in the order of 10" esu cm. Dipole moment is measured in "Debye" (D) unit.  $1D = 10^{-18}$  esu cm =  $3.33 \times 10^{-30}$  coulomb metre (In S.I. unit).

Dipole moment is indicated by an arrow having a symbol ( ) pointing towards the negative end. Dipole moment has both magnitude and direction and therefore it is a vector quantity.

Symmetrical polyatomic molecules are not polar so they do not have my value of dipole moment.





Unsymmetrical polyatomic molecules always have net value of dipole moment, thus such molecules are polar in nature. HO, CHCl, NH, etc are polar molecules as they have some positive values of dipole monitents.



 $\mu = 1.86D$ 

 $\mu \neq 0$  due to unsymmetry (1) Dipole moment is an important factor in determining the geometry of molecules.

Table : 3.1 Molec	cular geometry	and dipo	le moment
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General formula	Molecular geometry	Dipole moment	Example
AX	Linear	May be non zero	HF, HCl
$AX_2$	Linear Bent or V-shape	Zero Non zero	$CO_2, CS_2$ $H_2O, NO_2$
AX <sub>3</sub>	Triangular planar Pyramidal T-shape	Zero Non zero Non zero	BF <sub>3</sub> NH <sub>3</sub> , PCl <sub>3</sub> ClF <sub>3</sub>
$AX_4$	Tetrahedral	Zero	$CH_4, CCl_4$

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	Square planar	Zero	$XeF_4$
	See saw	Non zero	$SF_4, TeCl_4$
$AX_5$	Trigonal bipyramidal	Zero	PCl <sub>5</sub>
	Square pyramidal	Non zero	BrCl <sub>5</sub>
AX <sub>6</sub>	Octahedral	Zero	SF <sub>6</sub>
	Distorted octahedral	Non zero	XeF <sub>6</sub>
$AX_7$	Pentagonal bipyramidal	Zero	IF <sub>7</sub>

(2) Every ionic compound having some percentage of covalent character according to Fajan's rule. The percentage of ionic character in compound having some covalent character can be calculated by the following equation.

The % ionic character = 
$$\frac{\text{Observed }\mu}{\text{Theoretical }\mu} \times 100$$

(3) The trans isomer usually possesses either zero dipole moment or very low value in comparison to  $\emph{cis-form}$ 

$$\begin{array}{ccc} H-C-Cl & H-C-Cl \\ \parallel & \parallel \\ H-C-Cl & Cl-C-H \end{array}$$

#### Fajan's rule

The magnitude of polarization or increased covalent character depends upon a number of factors. These factors are,

(1) **Small size of cation :** *Smaller size of cation greater is its polarizing power i.e. greater will be the covalent nature of the bond.* 

(2) Large size of anion : Larger the size of anion greater is its polarizing power i.e. greater will be the covalent nature of the bond.

(3) Large charge on either of the two ions : As the charge on the ion increases, the electrostatic attraction of the cation for the outer electrons of the anion also increases with the result its ability for forming the covalent bond increases.

(4) **Electronic configuration of the cation :** For the two ions of the same size and charge, one with a pseudo noble gas configuration (i.e. 18 electrons in the outermost shell) will be more polarizing than a cation with noble gas configuration (i.e., 8 electron in outer most shell).

#### Valence bond theory or VBT

It was developed by Heitler and London in 1927 and modified by Pauling and Slater in 1931.

(1) To form a covalent bond, two atoms must come close to each other so that orbitals of one overlaps with the other.

(2) Orbitals having unpaired electrons of anti spin overlaps with each other.

(3) After overlapping a new localized bond orbital is formed which has maximum probability of finding electrons.

(4) Covalent bond is formed due to electrostatic attraction between radii and the accumulated electrons cloud and by attraction between spins of anti spin electrons.

(5) Greater is the overlapping, lesser will be the bond length, more will be attraction and more will be bond energy and the stability of bond will also be high.

(6) The extent of overlapping depends upon: Nature of orbitals involved in overlapping, and nature of overlapping.

(7) More closer the valence shells are to the nucleus, more will be the overlapping and the bond energy will also be high. (8) Between two sub shells of same energy level, the sub shell more directionally concentrated shows more overlapping. Bond energy : 2s - 2s < 2s - 2p < 2p - 2p

(9) *s* -orbitals are spherically symmetrical and thus show only head on overlapping. On the other hand, *p* -orbitals, are directionally concentrated and thus show either head on overlapping or lateral overlapping.Overlapping of different type gives sigma ( $\sigma$ ) and pi ( $\pi$ ) bond.

Sigma (ơ) bond	<i>Pi</i> $(\pi)$ bond
It results from the end to end overlapping of two <i>s</i> -orbitals or two <i>p</i> -orbitals or one <i>s</i> and one <i>p</i> - orbital.	It result from the sidewise (lateral) overlapping of two <i>p</i> -orbitals.
Stronger	Less strong
Bond energy 80 <i>kcals</i>	Bond energy 65 kcals
More stable	Less stable
Less reactive	More reactive
Can exist independently	Always exist along with a $\sigma$ -bond
The electron cloud is symmetrical about the internuclear axis.	The electron cloud is above and below the plane of internuclear axis.

#### **Hybridization**

The concept of hybridization was introduced by **Pauling** and **Slater**. Hybridization is defined as the intermixing of dissimilar orbitals of the same atom but having slightly different energies to form same number of new orbitals of equal energies and identical shapes. The new orbitals so formed are known as **hybrid orbitals**.

#### Characteristics of hybridization

(1) Only orbitals of almost similar energies and belonging to the same atom or ion undergoes hybridization.

 $\left(2\right)$  Hybridization takes place only in orbitals, electrons are not involved in it.

(3) The number of hybrid orbitals produced is equal to the number of pure orbitals, mixed during hybridization.

(4) In the excited state, the number of unpaired electrons must correspond to the oxidation state of the central atom in the molecule.

(5) Both half filled orbitals or fully filled orbitals of equivalent energy can involve in hybridization.

(6) Hybrid orbitals form only sigma bonds.

(7) Orbitals involved in  $\pi$  bond formation do not participate in hybridization.

(8) Hybridization never takes place in an isolated atom but it occurs only at the time of bond formation.

(9) The hybrid orbitals are distributed in space as apart as possible resulting in a definite geometry of molecule.

(10) Hybridized orbitals provide efficient overlapping than overlapping by pure s, p and d-orbitals.

(11) Hybridized orbitals possess lower energy.

*How to determine type of hybridization* : The structure of any molecule can be predicted on the basis of hybridization which in turn can be known by the following general formulation,

$$H = \frac{1}{2}(V + M - C + A)$$

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Where *H* = Number of orbitals involved in hybridization viz. 2, 3, 4, 5, 6 and 7, hence nature of hybridization will be *sp*, *sp*, *sp*, *spd*, *spd*, *spd* respectively.

- V = Number electrons in valence shell of the central atom,
- M = Number of monovalent atom
- *C* = Charge on cation,
- A = Charge on anion

#### Resonance

The phenomenon of resonance was put forward by **Heisenberg** to explain the properties of certain molecules.

In case of certain molecules, a single Lewis structure cannot explain all the properties of the molecule. The molecule is then supposed to have many structures, each of which can explain most of the properties of the molecule but none can explain all the properties of the molecule. The actual structure is in between of all these contributing structures and is called **resonance hybrid** and the different individual structures are called **resonating structures** or **canonical forms**. This phenomenon is called **resonance**.

To illustrate this, consider a molecule of ozone  $\,O_3^{}$  . Its structure can be written as



As a resonance hybrid of above two structures (*a*) and (*b*). For simplicity, ozone may be represented by structure (*c*), which shows the resonance hybrid having equal bonds between single and double.

Resonance is shown by benzene, toluene, O, allenes (>C = C = C<), CO, CO,  $CO_3^-$ , SO, NO, NO, while it is not shown by H,O, H,O, NH, CH, SiO.

As a result of resonance, the bond lengths of single and double bond in a molecule become equal e.g. O-O bond lengths in ozone or C-O bond lengths in  $CO_3^{2-}$  ion.

The resonance hybrid has lower energy and hence greater stability than any of the contributing structures.

Greater is the number of canonical forms especially with nearly same energy, greater is the stability of the molecule

Difference between the energy of resonance hybrid and that of the most stable of the resonating structures (having least energy) is called resonance energy. Thus,

Resonance energy = Energy of resonance hybrid – Energy of the most stable of resonating structure.

In the case of molecules or ions having resonance, the bond order changes and is calculated as follows,





#### **Bond characteristics**

(1) Bond length

"The average distance between the centre of the nuclei of the two bonded atoms is called bond length".

It is expressed in terms of Angstrom (1 Å =  $10^{-10}$  m) or picometer (1pm =  $10^{-12}$  m).

In an ionic compound, the bond length is the sum of their ionic radii  $(d = r_+ + r_-)$  and in a covalent compound, it is the sum of their covalent radii (e.g., for *HC*,  $d = r_H + r_{Cl}$ ).

#### Factors affecting bond length

(i) The bond length increases with increase in the size of the atoms. For example, bond length of H-X are in the order, HI > HBr > HCl > HF.

(ii) The bond length decreases with the multiplicity of the bond. Thus, bond length of carbon-carbon bonds are in the order,  $C \equiv C < C = C < C - C$ .

(iii) As an s-orbital is smaller in size, greater the s-character shorter is the hybrid orbital and hence shorter is the bond length.

For example, 
$$sp^3 C - H > sp^2 C - H > sp C - H$$

 $(\mathrm{iv})$  Polar bond length is usually smaller than the theoretical non-polar bond length.

#### (2) Bond energy

"The amount of energy required to break one mole of bonds of a particular type so as to separate them into gaseous atoms is called **bond dissociation energy** or simply **bond energy**". Greater is the bond energy,

stronger is the bond. Bond energy is usually expressed in  $kJ mol^{-1}$ .

#### Factors affecting bond energy

(i) Greater the size of the atom, greater is the bond length and less is the bond dissociation energy i.e. less is the bond strength.

(ii) For the bond between the two similar atoms, greater is the multiplicity of the bond, greater is the bond dissociation energy.

(iii) Greater the number of lone pairs of electrons present on the bonded atoms, greater is the repulsion between the atoms and hence less is the bond dissociation energy.

(iv) The bond energy increases as the hybrid orbitals have greater amount of *s* orbital contribution. Thus, *bond energy decreases in the following order,*  $sp > sp^2 > sp^3$ 

(v) Greater the electronegativity difference, greater is the bond polarity and hence greater will be the bond strength i.e., bond energy, H-F > H-Cl > H-Br > H-I,

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(vi) Among halogens Cl - Cl > F - F > Br - Br > l - l, (Decreasing order of bond energy) Resonance increases bond energy.

#### (3) Bond angle

In case of molecules made up of three or more atoms, the average angle between the bonded orbitals (i.e., between the two covalent bonds) is known as bond angle  $\theta$ .

#### Factors affecting bond angle

(i) Repulsion between atoms or groups attached to the central atom may increase or decrease the bond angle.

(ii) In hybridisation *as the s character of the s hybrid bond increases, the bond angle increases.* 

Bond type	sp	sp	sp
Bond angle	109°28′	120°	180°

(iii) By increasing lone pair of electron, bond angle decreases approximately by 2.5%.

	CH	NH,	HO
Bond angle	109°	107 <sup>-</sup>	105 <sup>.</sup>

 (iv) If the electronegativity of the central atom decreases, bond angle decreases.

In case the central atom remains the same, bond angle increases with the decrease in electronegativity of the surrounding atom.

 $PCl_3 \ PBr_3 \ PI_3$ ,  $AsCl_3 \ AsBr_3 \ AsI_3$ Bond angle  $100^\circ \ 101.5^\circ \ 102^\circ \ 98.4^\circ \ 100.5^\circ \ 101^\circ$ 

## Valence shell electron pair repulsion theory (VSEPR)

The basic concept of the theory was suggested by **Sidgwick** and **Powell** (1940). It provides useful idea for predicting shapes and geometries of molecules. The concept tells that, the arrangement of bonds around the central atom depends upon the repulsion's operating between electron pairs(bonded or non bonded) around the central atom. **Gillespie** and **Nyholm** developed this concept as VSEPR theory.

The main postulates of VSEPR theory are

(1) For polyatomic molecules containing 3 or more atoms, one of the atoms is called the central atom to which other atoms are linked.

(2) The geometry of a molecule depends upon the total number of valence shell electron pairs (bonded or not bonded) present around the central atom and their repulsion due to relative sizes and shapes.

(3) If the central atom is surrounded by bond pairs only. It gives the symmetrical shape to the molecule.

(4) If the central atom is surrounded by lone pairs (lp) as well as

bond pairs (bp) of  $e^-$  then the molecule has a distorted geometry. (5) The relative order of repulsion between electron pairs is as

follows  $\cdot |p - |p - bp - bp - bp$ .

A lone pair is concentrated around the central atom while a bond pair is pulled out between two bonded atoms. As such repulsion becomes greater when a lone pair is involved.

Type of mole-cule	No. of bond pairs of electron	No. of lone pairs of electrons	Hybridi- zation	Bond angle	Expected geometry	Actual geometry	Examples
$AX_3$	2	1	$sp^2$	< 120 <sup>.</sup>	Trigonal planar	V-shape, Bent, Angular	SO, SnCl, NO
$AX_4$	2	2	sp <sup>3</sup>	< 109 <sup>.</sup> 28′	Tetrahedral	V-shape, Angular	H,O, H,S, SCI, OF, NH, ClO
$AX_4$	3	1	$sp^3$	< 109 <sup>.</sup> 28′	Tetrahedral	Pyramidal	NH, NF, , PCl, PH, AsH, ClO, , HO
$AX_5$	4	1	$sp^{3}d$	< 109 <sup>.</sup> 28′	Trigonal bipyramidal	Irregular tetrahedron	SF, SCl, TeCl
$AX_5$	3	2	$sp^{3}d$	90 <sup>.</sup>	Trigonal bipyramidal	T-shaped	ICI, IF, CIF,
$AX_5$	2	3	$sp^{3}d$	180 <sup>.</sup>	Trigonal bipyramidal	Linear	XeF, 1, 1Cl
$AX_6$	5	1	$sp^3d^2$	< 90 <sup>-</sup>	Octahedral	Square pyramidal	1Cl, BrF, 1F,
$AX_6$	4	2	$sp^3d^2$	-	Octahedral	Square planar	XeF, ICl
AX,	6	1	$sp^3d^3$	_	Pentagonal pyramidal	Distorted octahedral	XeF

Table : 3.2 Geometry of Molecules/Ions having bond pair as well as lone pair of electrons

#### Molecular orbital theory or MOT

Molecular orbital theory was given by Hund and Mulliken in 1932.

The main ideas of this theory are,

(1) When two atomic orbitals combine or overlap, they lose their identity and form new orbitals. The new orbitals thus formed are called **molecular orbitals**.



(2) Molecular orbitals are the energy states of a molecule in which the electrons of the molecule are filled just as atomic orbitals are the energy states of an atom in which the electrons of the atom are filled.

(3) In terms of probability distribution, a molecular orbital gives the electron probability distribution around a group of nuclei just as an atomic orbital gives the electron probability distribution around the single nucleus.

(4) Only those atomic orbitals can combine to form molecular orbitals which have comparable energies and proper orientation.

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bond

(5) The number of molecular orbitals formed is equal to the number of combining atomic orbitals.

(6) When two atomic orbitals combine, they form two new orbitals called bonding molecular orbital and antibonding molecular orbital.

(7) The bonding molecular orbital has lower energy and hence greater stability than the corresponding antibonding molecular orbital.

(8) The bonding molecular orbitals are represented by  $\sigma, \pi$  etc, whereas the corresponding antibonding molecular orbitals are represented by  $\sigma^*, \pi^*$  etc.

(9) The shapes of the molecular orbitals formed depend upon the type of combining atomic orbitals.

(10) The filling of molecular orbitals in a molecule takes place in accordance with Aufbau principle, Pauli's exclusion principle and Hund's rule. The general order of increasing energy among the molecular orbitals formed by the elements of second period and hydrogen and their general electronic configurations are given below.

(11) Electrons are filled in the increasing energy of the MO which is in order





#### Hydrogen bonding

In 1920, Latimer and Rodebush introduced the idea of "hydrogen bond"

For the formation of *H*-bonding the molecule should contain an atom of high electronegativity such as F, O or N bonded to hydrogen atom and the size of the electronegative atom should be quite small.

#### Types of hydrogen bonding

(1) Intermolecular hydrogen bond : Intermolecular hydrogen bond is formed between two different molecules of the same or different substances

(i) Hydrogen bond between the molecules of hydrogen fluoride.



Increasing energy (for electrons  $\leq 14$ ) (12) Number of bonds between two atoms is called

order and is given by

Bond order 
$$=\left(\frac{N_B - N_A}{2}\right)$$

where  $N_B$  = number of electrons in bonding *MO*.

 $N_A$  = number of electrons in antibonding *MO*.

For a stable molecule/ion,  $N_B > N_A$ 

(13) Bond order 
$$\propto$$
 Stability of molecule  $\propto$  Dissociation energy  $\propto$ 

Bond length

(14) If all the electrons in a molecule are paired then the substance is a diamagnetic on the other hand if there are unpaired electrons in the molecule, then the substance is paramage-tic. More the number of unpaired electron in the molecule greater is/the pa amagnetism of the substance.



#### Molecular orbital energy level diagram obtained by the overlap of 2s and $2p_z$ atomic orbitals after mixing

(Applicable for elements with Z < 7) (ii) Hydrogen bond in alcohol and water molecules

#### (2) Intramolecular hydrogen bond (Chelation)

Intramolecular hydrogen bond is formed between the hydrogen atom and the highly electronegative atom (F, O or N) present in the same molecule. Intramolecular hydrogen bond results in the cyclisation of the molecules and prevents their association. Consequently, the effect of intramolecular hydrogen bond on the physical properties is negligible.

For example : Intramolecular hydrogen bonds are present in molecules such as o-nitrophenol, o-nitrobenzoic acid, etc.



Ortho nitrophenol Ortho nitrobenzoic acid

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The extent of both intramolecular and intermolecular hydrogen bonding depends on temperature.

#### Effects of hydrogen bonding

Hydrogen bond helps in explaining the abnormal physical properties in several cases. Some of the properties affected by H-bond are given below,

(1) **Dissociation :** In aqueous solution, hydrogen fluoride dissociates and gives the difluoride ion  $(HF_2^-)$  instead of fluoride ion  $(F^-)$ . This is due to *H*-bonding in *HF*. This explains the existence of  $KHF_2$ . *H*-bond formed is usually longer than the covalent bond present in the molecule (e.g. in *H*<sub>.</sub>O, *O*-*H* bond = 0.99 Å but *H*-bond = 1.77 Å).

(2) **Association :** The molecules of carboxylic acids exist as dimers because of the hydrogen bonding. The molecular masses of such compounds are found to be double than those calculated from their simple formulae. For example, molecular mass of acetic acid is found to be 120.

(3) **High melting and boiling point :** The compounds having hydrogen bonding show abnormally high melting and boiling points.

The high melting points and boiling points of the compounds  $(H_2O, HF \text{ and } NH_3)$  containing hydrogen bonds is due to the fact that some extra energy is needed to break these bonds.

(4) **Solubility**: The compound which can form hydrogen bonds with the covalent molecules are soluble in such solvents. For example, *lower alcohols are soluble in water because of the hydrogen bonding which can take place between water and alcohol molecules* as shown below,

The intermolecular hydrogen bonding increases solubility of the compound in water while, the intramolecular hydrogen bonding decreases.



Due to chelation, – *OH* group is not available to form hydrogen bond with water hence it is sparingly soluble in water.  OH group available to form hydrogen bond with water, hence it is completely soluble in water. (5) As the compounds involving hydrogen bonding between different molecules (intermolecular hydrogen bonding) have higher boiling points, so they are less volatile.

(6) The substances which contain hydrogen bonding have higher viscosity and high surface tension.

(7) Explanation of lower density of ice than water and maximum density of water at 277K : In case of solid ice, the hydrogen bonding gives rise to a cage like structure of water molecules as shown in following figure. As a matter of fact, each water molecule is linked tetrahedrally to four other water molecules. Due to this structure ice has lower density than water at 273K. That is why ice floats on water. On heating, the hydrogen bonds start collapsing, obviously the molecules are not so closely packed as they are in the liquid state and thus the molecules start coming together resulting in the decrease of volume and hence increase of density. This goes on upto 277K. After 277 K, the increase in volume due to expansion of the liquid water becomes much more than the decrease in volume due to breaking of H-bonds. Thus, after 277K, there is net increase of volume on heating which means decrease in density. Hence density of water is maximum 277K.



Cage like structure of H2O in the ice

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## F SCORER 98 Chemical Bonding

- $\mathscr{E}$  A chemical bond is expected to be formed when the energy of the aggregate formed is about 40 *kJ mole* lower than the separate particles.
- E Formation of a chemical bond is always an exothermic process.
- $\textbf{\textbf{L}}$  Lattice energies of bi-bivalent solids > bi-univalent solids > uniunivalent solids. For example, lattice energy of  $Mg^{2+}O^{2-}(3932 \ kJ \ mole^{-1}) > Ca^{2+}(F^{-})_2 \ (2581 \ kJ \ mole^{-1}) > Li^+F^-(1034 \ kJ \ mole^{-1}).$
- When co-ordination number increases, the coulombic forces of attraction increases and hence stability increases.
- Ionic solids have negative vapour pressure.
- As a general rule, atomic crystals are formed by the lighter elements of the middle columns of the periodic table.
- $\textit{\textit{E}} \quad FeCl_3 \text{ is more covalent than } FeCl_2 \text{ because polarising power of } \\ Fe^{3+} \text{ is more than that of } Fe^{2+}. \text{ Similarly } SnCl_4 \text{ is more } \\ \text{covalent than } SnCl_2.$
- Boron forms the maximum number of electron deficient compounds than any other elements in the periodic table.
- € Roughly each lone pair decreases the bond angle by 2.5°.
- C Greater the number of the lone pairs at the two bonding atoms, greater is the repulsion between them and weaker is the bond.
- The actual number of s- and p-electrons present in the outermost shell of the element is called maximum covalency of that atom.
- The hydrogen bonds are tetrahedral in their directions and not planar.
- **E** The hydrogen bond is stronger in *HF* and persists even in vapour state. Such bonds account for the fact that gaseous hydrogen fluoride is largely polymerised into the molecular species  $H_2F_2, H_3F_3, H_4F_4, H_5F_5$  and  $H_6F_6$ .
- Mydrogen bonding is strongest when the bonded structure is stabilised by resonance.
- $\mathscr{K}$  Critical temperature of water is higher than that of  $O_2$  because  $H_2O$  molecule has dipole moment.



	Electrova	lent bonding
	Electiona	
1.	Which forms a crystal of $N$	
	$() M_{\alpha}Cl = 1 = 1$	[CPMT 1972; NCERT 1976; DPMT 1996]
	(a) $Na = 1 Cl$ is	(b) $Iva$ and $CI$ tons
2	(c) $Iva$ and $Cl$ atoms When sodium and chlorine	(d) None of the above
4.	(a) Energy is released and	ionic bond is formed
	(b) Energy is released and	a covalent bond is formed
	(c) Energy is absorbed and	l ionic bond is formed
	(d) Energy is absorbed and	l covalent bond is formed
3.	Which one is least ionic in t	he following compounds
	(a) AgCl	
	(c) $BaCl$	$(d) CaCl_{a}$
4	The electronic configuration	(u) curve $I$ $P$ $O$ and $R$ are
- <b>T</b> •	given in brackets	in a loar cicinento L, I, Q and I ale
	$L(1s^2, 2s^2 2p^4) O(1s^2)$	$2s^2 2p^6, 3s^2 3p^5$
	n(1-2, 2-2, 2, 6, 2, 1)	(1-2) - 2 - 2 - 2 - 6 - 2 - 2)
	$r(1s, 2s, 2p^2, 3s^2), R$	(1s, 2s, 2p, 5s)
	i ne formulae of ionic comp	ounds that can be formed between these
	(a) $L_2P$ , $RL_2PO$ and $L_2P$	$R_2O$ (b) LP, RL PO and RO
		PO  (d)  IP  P  I  D  O  ad  PO
_	(c) $\Gamma_2 L$ , $\Lambda L$ , $\Gamma Q$ and $\Gamma$	$(Q_2  (d)  Lr, \ R_2L, \ r_2Q \text{ and } RQ$
5.	(a) Melting points are low	[MP PMT 1984]
	(b) Boiling points are low	
	(c) Conduct current in fus	ed state
$\mathbf{U}$	(d) Insoluble in polar solve	ent
6.	A electrovalent compound is	s made up of [CPMT 1078 St. MNR 1070]
	(a) Electrically charged mo	lecules
	(b) Neutral molecules	
	(c) Neutral atoms	<i>c</i>
-	(d) Electrically charged ato	oms or group of atoms
7.	(a) lonization energy	(b) Electron affinity
	(c) Lattice energy	(d) All the three above
8.	In the following which subst	tance will have highest boiling point [NCI
	(a) He	(b) <i>CsF</i>
	(c) $NH_3$	(d) $CHCl_3$
9.	An atom of sodium loses on	e electron and chlorine atom accepts one
	electron. This result the for	mation of sodium chloride molecule. This
	type of molecule will be	[MD DMT 1087]
	(a) Coordinate	(b) Covalent
	(c) Electrovalent	(d) Matallic bond
10.	Formula of a metallic oxide	is $MO$ . The formula of its phosphate
	will be	[CPMT 1986, 93]
	(a) $M_2(PO_4)_2$	(b) $M(PO_4)$
	(c) $M_2 PO_4$	(d) $M_{2}(PO_{4})_{2}$
11	From the following which $\infty$	(-)
11.	(a) $F C^{\dagger} R^{\mu}$	(b) $Ii Na V$
	(c) $O, S, Se$	(d) $N, P, As$
12.	Which type of compounds s	how high melting and boiling points

- (a) Electrovalent compounds
- (b) Covalent compounds

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	(c) Coordinate compounds	22	In the transition of $7n$ atoms to $7n^{++}$ ions there is a decrease in
	(d) All the three types of compounds have equal melting and boiling points	23.	the [CPMT 1972]
13.	Lattice energy of an ionic compound depends upon		(a) Number of valency electrons
	[AIEEE 2005]		(c) Atomic number
	(a) Charge on the ion only		(d) Equivalent weight
	(b) Size of the ion only		(d)  Equivalent weight $(d)  Equivalent weight$ $M = (D)  The formula$
	(c) Packing of ions only	24.	Prosphate of a metal <i>M</i> has the formula $M_3(PO_4)_2$ . The formula
	(d) Charge on the ion and size of the ion		for its suipnate would be
14.	In the given bonds which one is most ionic		
			(a) $MSO_4$ (b) $M(SO_4)_2$
	(a) $CS - CI$ (b) $AI - CI$		(c) $M_2(SO_4)_3$ (d) $M_3(SO_4)_2$
	(c) $C - Cl$ (d) $H - Cl$	25.	The molecular formula of chloride of a metal $M$ is $MCl_3$ . The
15.	Element $x$ is strongly electropositive and $y$ is strongly		formula of its carbonate would be [CPMT 1987]
	from their combination will be [IIT 1980]		(a) $MCO_3$ (b) $M_2(CO_3)_2$
	(a) $x^+y^-$ (b) $x^-y^+$		(c) $M_2CO_3$ (d) $M(CO_3)_2$
	(c) $x - y$ (d) $x \rightarrow y$	26.	Sodium chloride easily dissolves in water. This is because
16	In the formation of NaCl from Na and Cl [CDMT 108]		[NCERT 1972; BHU 1973]
10.	(a) Sodium and chlorine both give electrons		(a) It is a covalent compound
	(b) Sodium and chlorine both accept electrons		(b) Salt reacts with water
	(c) Sodium loses electron and chlorine accepts electron		(c) It is a white substance
	(d) Sodium accepts electron and chlorine loses electron		(d) Its ions are easily solvated
17.	Which of the following is an electrovalent linkage	27.	When <i>NaCl</i> is dissolved in water the sodium ion becomes
	[CPMT 1974; DPMT 1984, 91; AFMC 1988]		[NCERT 1974; CPMT 1989; MP PMT 1999]
	(a) $CH_4$ (b) $MgCl_2$		(a) Oxidized (b) Reduced
	(c) $SiCl_4$ (d) $BF_2$	( )	(c) Hydrolysed (d) Hydrated
18	Electrovalent compounds do not have [CPMT 1991]	28.	Solid NaCl is a bad conductor of electricity since
.0.	(a) High M.P. and Low B.P. (b) High dielectric constant		[AFMC 1980]
	(c) High M.P. and High B.P. (d) High polarity		(a) In solid NaCl there are no ions
19.	Many ionic crystals dissolve in water because		(b) Solid NaCl is covalent
	[NCERT 1982]		(c) In solid NaCl, there is no motion of ions
	(a) Water is an amphiprotic solvent		(c) in solid <i>NaCl</i> there is no motion of forms
	(b) Water is a high boiling liquid		(d) In solid $NaCl$ there are no electrons
	(d) Water decreases the interionic attraction in the crystal	29.	Favourable conditions for electrovalency are
	lattice due to solvation		(a) Low charge on ions, range cation, small anion (b) High charge on ions small cation large anion
20.	The electronic structure of four elements A, B, C, D are		(c) High charge on ions, large cation, small anion
	(A) $1s^2$ (B) $1s^2 2s^2 2n^2$		(d) Low charge on ions, small cation, large anion
	(1) 13 $(0)$ 13 $25$ 2p	30.	The sulphate of a metal has the formula $M_2(SQ_4)_2$ . The formula
	(C) $1s^2$ , $2s^2 2p^5$ (D) $1s^2$ , $2s^2 2p^6$	0	for its phosphate will be
	The tendency to form electrovalent bond is largest in		[DPMT 1982; CPMT 1972; MP PMT 1995]
	[MNR 1987, 95]		(a) $M(HPO_A)_2$ (b) $M_3(PO_A)_2$
	(a) A (b) B		$(-) M (PQ) \qquad (1) MPQ$
	(c) <i>C</i> (d) <i>D</i>		(c) $M_2(I O_4)_3$ (d) $MI O_4$
21.	Chloride of metal is $MCl_2$ . The formula of its phosphate will be	31.	(a) High ionisation potential and low electron affinity
	(a) $M_2 PO_4$ (b) $M_3 (PO_4)_2$		(b) Low ionisation potential and high electron affinity
	(c) $M_2(PO_A)_2$ (d) $MPO_A$		(c) High ionisation potential and high electron affinity
	The absorber of a model has the first MDO with first first		(d) Low ionisation potential and low electron affinity
22.	The phosphate of a metal has the formula $MPO_4$ . The formula of	32.	Molten sodium chloride conducts electricity due to the presence of
	Its nitrate will be [CPMT 1971; MP PMT 1996]		(a) Free electrons
	(a) $MNO_3$ (b) $M_2(NO_3)_2$		(b) Free ions
	(c) $M(NO_3)_2$ (d) $M(NO_3)_3$		(c) Free molecules
			(d) Atoms of sodium and chlorine

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UNIT	IOO Chemical Bonding		
33.	The phosphate of a metal has the formula $MHPO_4$ . The formula of its chloride would be	45.	Out of the following, which compound will have electrovalent bonding
	[NCERT 1974; CPMT 1977]		(a) Ammonia (b) Water
	(a) $MCl$ (b) $MCl_2$	46	(c) Calcium chloride (d) Chloromethane
	(c) $MCl_3$ (d) $M_2Cl_3$	40.	(a) Vander Waal's force
34.	A number of ionic compounds <i>e.g.</i> $AgCl$ , $CaF_2$ , $BaSO_4$ are		(b) Dipole attraction force
	insoluble in water. This is because [NCERT 1984]		(c) Electrostatic force of attraction
	(a) Ionic compounds do not dissolve in water		(d) All the above
	(b) Water has a high dielectric constant	47.	The main reaction during electrovalent bond formation is
	(c) Water is not a good ionizing solvent		(a) Redox reaction (b) Substitution reaction
	(d) These molecules have exceptionally high alternative forces in the lattice		(c) Addition reaction (d) Elimination reaction
35	What is the nature of chemical bonding between $Cs$ and $F$	48.	Electrovalent compounds are [CPMT 1996]
55.	[MP PMT 1987; CPMT 1976]		(a) Good conductor of electricity
	(a) Covalent (b) Ionic		(b) Polar in nature
	(c) Coordinate (d) Metallic		(c) Low M.P. and low B.P.
36.	Which one of the following compound is ionic	40	(d) Easily available
	[MNR 1985]	49.	(a) Hard and brittle nature
	(a) $KCl$ (b) $CH_4$		(b) High melting and boiling point
	(c) Diamond (d) $H_2$		(c) Directional properties
37.	Which of the following compound has electrovalent linkage		(d) Soluble in polar solvents
	[CPMT 1983, 84, 93]	50.	Highest melting point would be of [RPMT 1999]
	(a) $CH_3Cl$ (b) $NaCl$		(a) He (b) CsCl
	(c) $CH_4$ (d) $Cl_2$		(c) $NH_3$ (d) $CHCl_3$
38.	An ionic compound is generally a [MADT Bihar 1981]	51.	What is the effect of more electronegative atom on the strength of
	(a) Good electrolyte (b) Weak electrolyte	U	ionic bond [AMU 1999]
	(c) Non-electrolyte (d) Neutral		(a) Decreases (b) Increases
39.	What metals combine with non-metals, the metal atom tends to		(c) D <b>{AMII 3983</b> wly (d) Remains the same
	(a) Lose electrons	52.	An element X with the electronic configuration $1s^2$ , $2s^2 2p^6$ , $3s^2$
	(b) Gain electrons (c) Remain electrically poutral		would be expected to form the chloride with the formula
	(d) None of these		(a) $XCl_3$ (b) $XCl_2$
40	Chamical formula for calcium numericanharmente in <b>Ca B O</b> . The		(c) $XCl$ (d) $X_2Cl$
40.	formula for ferric pyrophosphate will be $\left[ NCFBT 1077 \right]$	52	Two element have electronegativity of 12 and 20. Bond formed
	(a) $E_a(P,Q)$ (b) $E_a(P,Q)$	55.	between them would be [CPMT 1982; DCE 2000]
	(a) $re_3(r_2O_7)_3$ (b) $re_4r_4O_{14}$		(a) Ionic (b) Polar covalent
	(c) $Fe_4(P_2O_7)_3$ (d) $Fe_3PO_4$		(c) Co-ordinate (d) Metallic
41.	Among the bonds formed by a chlorine atom with atoms of	54.	Which of the following is least ionic [MP PET 2002]
	formed between		(a) $C_2H_5Cl$ (b) $KCl$
	(a) $H - Cl$ (b) $Cl - Cl$		(c) $BaCl_2$ (d) $C_c H_c N^+ H_2 Cl^-$
	$\begin{array}{c} (c)  Na = Cl \\ (c)  Na = Cl \\ (d)  C = Cl$		
42.	Which of the following is least soluble [CPMT 1989]	55.	Which type of bonding exists in $Ll_2O$ and $Car_2$ respectively
•	(a) $BeF_2$ (b) $SrF_2$		(a) lonic ionic (b) lonic covalent
			(c) Covalent, ionic (d) Coordinate, ionic
	(c) $CaF_2$ (d) $MgF_2$	56.	An atom with atomic number 20 is most likely to combine
43.	Which of the following halides has maximum melting point	-	chemically with the atom whose atomic number is
	(a) NaCl (b) NaBr		[BHU 2000]
	(c) NaI (d) NaF		(a) 11 (b) 14
44.	The high melting point and insolubility in organic solvents of		(c) 1b (d) 10 $P_{1} = d f_{1} = m_{1} + 1 + \frac{1}{2} +$
	(a) Simple ionic (b) Bipelar ionic	57.	DUILU FORMED IN CRYSTAL DY ANION AND CATION IS
	(c) Cubic (d) Hexagonal		(a) Ionic (b) Metallic
			(,, , , , , , , , , , , , , , , , , , ,

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			Ch	emical Bonding 101	UNIVERSAL SELF SCORER
	(c) Covalent (d) Dipole		(c) 6	(d) 10	
58.	Atoms or group of atoms which are electrically charged are known	3.	The elec <b>urstian coold</b> urati	on of four elements are given	in brackets
	(a) Anions (b) Cations		$L(1s^2, 2s^22p^1), M(1s)$	$(2^{2}, 2s^{2} 2p^{5})$	
	(c) lons (d) Atoms		(1, 2, 2, 2, 6, 2, 1)	$r(r^2, r^2, r^2)$	)`
59.	Which one is the strongest bond [Pb. PMT 2001]		$Q(1s^2, 2s^2, 2p^3, 3s^2);$	$R(1s^2, 2s^2 2p^2)$	
	(a) $Br-F$ (b) $F-F$		The element that would n	nost readily form a diatomic 1	nolecule is
	(c) $Cl-F$ (d) $Br-Cl$		(a) $O$	(b) <i>11</i>	[NCERT 1983]
60.	The interionic attraction depends on interaction of		(a) $Q$ (c) $R$	(d) L	
	[Kerala CET (Med.) 2002]	4.	In covalency	[CPMT 1974, 76, 78,	81; AFMC 1982]
	(a) Solute-Solute (b) Solvent-Solvent		(a) Electrons are transfe	rred	
<i>.</i>	(c) The charges (d) Molecular properties		(b) Electrons are equally	shared	
61.	Which of the following compounds is ionic		(d) None of the above	atom are shared between two a	itoms
		5.	Which compound is high	est covalent	
	(a) $\mathbf{M}$ (b) $\mathbf{C}\mathbf{M}_4$		(a) LiCl	(b) <i>LiF</i>	
	(c) Diamond (d) $H_2$		(c) LiBr	(d) Lil	
62.	Which of the following pairs of species has same electronic	6.	The nature of bonding in	graphite is	86. CPMT 1086]
	configuration [UPSEAT 2002]		(a) Covalent	(b) Ionic	, ci ili 1900]
	(a) $Zn^{2+}$ and $Ni^{2+}$ (b) $Co^{+3}$ and $Ni^{4+}$		(c) Metallic	(d) Coordinate	
	(c) $Co^{2+}$ and $Ni^{2+}$ (d) $Ti^{4+}$ and $V^{3+}$	7.	Which of the following	substances has giant coval	lent structure
63.	The energy that opposes dissolution of a solvent is		(a) lodine crystal	(b) Solid $CO_{2}$	
	[CPMT 2002]		(c) Silica	(d) White phospho	r115
	(a) Internal energy (b) Lattice energy	8.	With which of the given p	pairs <i>CO</i> resembles	[BHU 2005]
64	Which of the following has highest melting point	(	(a) HgCl, CH	(b) HgCl, SnCl	
~7.	[RPET 2003]		(c) <i>C</i> , <i>H</i> , <i>NO</i> ,	(d) $N_i O$ and $NO_i$	
	(a) $BeCl_2$ (b) $MgCl_2$	9.	The electron pair which	forms a bond between two	similar non-
	$(r)  CaCl \qquad (1)  BaCl$		(a) Dissimilar shared be	tween the two	[111.1886]
<b>.</b>	$\begin{array}{c} (c)  cact_2 \\ (d)  bact_2 \\$	Γ.	(b) By complete transfer	from one atom to other	
65.	(a) High making point	ET 2003]	(c) In a similar spin con	dition	
	(a) Fight metring point (b) Least lattice energy	10	(d) Equally shared in be	tween the two	ll
	(c) Least solubility in organic compounds	10.	electronegativities should	be [EAMCET 1982]	i the value of
	(d) Soluble in water		(a) Equal to or less than	1.7 (b) More than 1.7	
66.	Electrolytes are compound containing [MADT Bihar 1981]		(c) 1.7 or more	(d) None of these	
	(a) Electrovalent bond (b) Covalent bond	11.	Which type of bond is for	med between similar atoms	
	(c) Coordinate bond (d) Hydrogen bond		(a) Ionic (c) Coordinate	(d) Metallic	
67.	Which of the following hydrides are ionic [Roorkee 1999]	12.	Covalent compounds are	generally in water	
	(a) $CaH_2$ (b) $BaH_2$		() $()$ $()$	(1) 1 1 1	[CPMT 1987]
	(c) $SrH_2$ (d) $BeH_2$		(a) Soluble (c) Dissociated	(D) Insoluble (d) Hydrolysed	
68.	Which of the following conduct electricity in the fused state	13.	Which one is the electron	deficient compound	[AIIMS 1982]
	[Roorkee 2000]		(a) ICl	(b) $NH_3$	
	(a) $BeCl_2$ (b) $MgCl_2$		(c) $BCl_3$	(d) $PCl_3$	
	(c) $SrCl_2$ (d) $BaCl_2$	14.	Which among the follow	ving elements has the tend	ency to form
			covalent compounds		
	Covalent bonding		(a) $Ba$ (c) $Ma$	(b) $Be$ (d) $Ca$	
1.	The valency of support in support acid is <b>INCERT 1074</b> ]	15	Silicon has 1 electrons in	u) Cu the outermost arbit in form	ing the bonde
••	(a) 2 (b) 4	·J·	(a) It gains electrons	(b) It loses electron	is
	(c) 6 (d) 8		(c) It shares electrons	(d) None of these	
2.	The number of electrons involved in the bond formation of	16.	Which of the following or	ccurs when two hydrogen ato	ms bond with
	$N_2$ molecule		each others		
	[IIT 1980; CPMT 1983, 84, 85; CBSE PMT 1992]		(a) Potential energy is lo	owered	
	(a) 2 (b) 4		(b) Kinetic energy is low	vered	

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	(c)	Electronic motion ceases				(a)	$LiCl < NaCl < BeCl_{2}$	(b)	BeCl <sub>2</sub> < Na	Cl 🗸 iCl
	(d)	Energy is absorbed				(-)		(-)		
17.	Ab	oond with maximum cov	alent character betw	veen non-metallic		(c)	NaCl < LiCl < BeCl <sub>2</sub>	(d)	$BeCl_2 < LiC$	I < NaCi
	(a)	Between identical atoms		[NCERT 1982]	27.	Bon	d energy of covalent $O-$ .	H bond	l in water is	[EAMCET 1982]
	(b)	Between chemically simila	ar atoms			(a)	Greater than bond energy	of $H$	– bond	
	(c)	Between atoms of widely	different electronegat	tivities		(b)	Equal to bond energy of	H - bc	ond	
	(d)	Between atoms of the sar	me size			(c) (a)	Less than hand anormy of	<i>H</i> _h	and	
18.	Amo	ongst the following covalen	nt bonding is found in	1		(c) (d)	None of these	<i>II</i> – U	lond	
				[CPMT 1973]	- 0	(u)				
	(a)	Sodium chloride	(b) Magnesium	chloride	28.	Solid	$1 CH_4$ is		1 . 1.1	[DPM111983]
	(c)	Water	(d) Brass			(a)	Molecular solid	(b)	lonic solid	
19.	Indi	cate the nature of bonding	, in diamond			(c)	Pseudo solid	(d)	Does not exist	1.1
			EAMCET 1980; BHL	I 1996; KCET 2000]	29.	A co	ovalent bond is likely to be	formed	between two el	ements which
	(a)	Covalent	(b) Ionic			(a)	Have similar electronegat	vities		
	(c)	Coordinate	(d) Hydrogen			(b)	Have low ionization energy	gies		
20.	Oct	et rule is not valid for the	molecule			(c)	Have low melting points			
			נ דוון	979; MP PMT 1995]		(d)	Form ions with a small cl	narge		
	(a)	$CO_2$	(b) $H_2O$		30.	The elect	bond between two iden trons	tical no	on-metal atoms	has a pair of [CPMT 1986]
	(c)	CO	(d) <i>O</i> <sub>2</sub>			(a)	Unequally shared between	1 the tw	/0	
21.	Whi	ich of the following compo	unds are covalent			(b)	Transferred fully from on	e atom	to another	
			[11]	Г 1980; MLNR 1982]		(c)	With identical spins			
	(a)	$H_2$	(b) <i>CaO</i>			( <b>d</b> )	Equally shared between the	nem		
	(c)	KCl	(d) $Na_2S$		31.	The	valency of phosphorus in	$H_3PC$	$P_4$ is	[DPMT 1984]
22.	Indi	cate the nature of bonding	g in $CCl_{1}$ and $CaH$	2	$\bigcirc$	(a)	2	(b)	5	
			,	2 [NCERT 1072]		(c)	4	(d)	1	
	$(\mathbf{a})$	Covalant in CCL and a	lastrovalant in CaH	[1001011975]	32.	Whi	ch of the following substar	nces has	covalent bondi	ıg
	(d)	$covarent in cci_4$ and e		2						[AMU 1985]
	(b)	Electrovalent in both CC	$\mathcal{I}_4$ and $\mathcal{C}aH_2$	$\mathbf{O}$		(a)	Germanium	(b)	Sodium chlorid	le
	(c)	Covalent in both $CCl_4$ a	and $CaH_2$	X		(c)	Solid neon	(d)	Copper	
	(d)	Electrovalent in $CCl_4$ and	nd covalent in CaH	2	33.	The	covalency of nitrogen in 1	$HNO_3$	is	[CPMT 1987]
23.	lf tl	he atomic number of eler	ment $X$ is 7, the	best electron dot		(a)	0	(b)	3	
	sym	bol for the element is	[NCERT	[ 1973; CPMT 2003]		(c)	4	(d)	5	
	(a)	Χ.	(b) . X .		34.	Hyd	rogen chloride molecule co	ontains a	a [CPMT 1984]	
	. ,					(a)	Covalent bond	(b)	Double bond	
	(c)	. X :	(d) $: X$ .			(c)	Coordinate bond	(d)	Electrovalent b	ond
24	w/b	ich is the most equalent			35.	As	compared to covalent c	ompou	nds, electrovale	nt compounds
24.	(a)	C = O	C = Br			gen			[CPMT 1990, 94	L: MP PMT 1997]
	(a)	C = 0	$\begin{array}{c} (\mathbf{d})  \mathbf{C} = \mathbf{B} \mathbf{f} \\ \mathbf{C} = \mathbf{F} \end{array}$			(a)	Low melting points and lo	ow boili	ing points	.,
<b></b>	(C) The			·		(b)	Low melting points and h	igh boi	ling points	
<b>4</b> 3.	The	covalent compound 11Ci		[FAMCET 1080]		(c)	High melting points and l	ow boil	ing points	
	(a)	The electronegativity of	f hydrogen is great	er than that of		(d)	High melting points and l	high bo	iling points	
	( )	chlorine	, , , , , , , , , , , , , , , , , , , ,		36	(-) The	interatomic distances in	H <sub>a</sub> ar	nd <i>Cla</i> molecu	les are 74 and
	(b)	The electronegativity of h	nydrogen is equal to t	hat of chlorine	30.	100	nm respectively The her-J	length	of $HC1$ is	.es are 74 anu
	(c)	The electronegativity of	f chlorine is greate	er than that of		198	pur respectively. The bond	rength		[MP PET 1993]
	(J)	Hydrogen and chloring ar	re asses			(a)	272 <i>pm</i>	(b)	136 <i>pm</i>	
26	(u) TI	and children and children at	ne gases	ton in nonnoscete J		(c)	124 <i>pm</i>	(d)	248 <i>pm</i>	
<b>20</b> .	by	[CBSE PMT 2005]	asing covalent charac	ter is represented	37.	On oxyg	analysis, a certain compo gen in the ratio of 254 g	und wa m of i	s found to cont iodine and 80	ain iodine and g <i>m</i> of oxygen.

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	(d) Covalent molecules are hele	d by weak Vander Waal's force o	f	(a) 8 (c) 6	(b) 5 (d) 7
57.	<i>p</i> and <i>n</i> -type of semiconductors a	re formed due to	70.	(c) o Hydrogen atoms are held toge (a) Hydrogen bond	(d) 7 ether to form hydrogen molecules by (b) Jonic bond
	(a) Covalent bonds	(b) Metallic bonds	1	(c) Covalent bond	(d) Dative bond
	(c) Ionic bonds	(d) Co-ordinate bond	71.	Strongest bond is	[AFMC 1987]
58.	Which of the following is Lewis a	cid [RPET 2003	]	(a) $C - C$ (a) $C - N$	(b) $C - H$
	(a) $BF_3$	(b) $NH_3$	72.	The major binding force of di	amond, silicon and quartz is
	(c) <i>PH</i> <sub>3</sub>	(d) $SO_2$		(a) Electrostatic force	[Kerala CET (Med.) 2002 (b) Electrical attraction
59.	Among the species : $CO_2, C_2$	$H_3COO^-$ , $CO, CO_3^{2-}$ , $HCHC$	)	(c) Co-valent bond force	(d) Non-covalent bond force
	which has the weakest carbon- o	xygen bond	/3.	(a) $H$	(b) $F$
		[Kerala PMT 2004	]	(a) $\Pi_2$	$P_2$
	(a) <i>CO</i> <sub>2</sub>	(b) $CH_3COO^-$		(c) $C_2H_4$	(d) $N_2$
	(a) $CO$	(d) $CO^{2-}$	74.	Which of the following does r	tot obey the octet rule
		(d) $CO_3$			
<b>6</b> -	(e) HCHO			(a) CO	
60.	Valency of sulphur in $Na_2S_2O_3$	is [DPMT 1984	]	(c) $H_2O$	(d) $PCl_5$
	(a) Two	(b) Three	75.	Which of the following statem	ents is correct for covalent bond
	(c) Four	(d) Six		(a) Electrons are shared betw	ween two atoms
61.	The acid having $O - O$ bond is			(b) It may be polar or non-p	oolar
			J	(d) Valency electrons are att	racted
	(a) $H_2 S_2 O_3$	(b) $H_2 S_2 O_6$	76.	Among $CaH_2$ , $NH_2$ , $NaH$	and $B_2H_2$ , which are covalent
	(c) $H_2 S_2 O_8$	(d) $H_2 S_4 O_6$		hydride	Orissa IEE 2005
62.	The following salt shows maximu	m covalent character		(a) $NH_3$ and $B_2H_6$	(b) $NaH$ and CaH <sub>2</sub>
		[UPSEAT 2004		(c) NaH and $NH_2$	(d) $CaH_2$ and $B_2H_6$
	(a) $AlCl_3$	(b) $MgCl_2$			
	(c) $CsCl$	(d) $LaCl_3$		Co-ordinate or	Dative bonding
63.	Which type of bond is present in	$H_2S$ molecule	<b>.</b>	Which species has the maximum	um number of lone pair of electrons
	(a) Ionic bond	(b) Covalent bond	]	(a) $[CO]^{-}$	(b) $Y_{eF}$
	(c) Co-ordinate	(d) All of three		(a) $[COC_{,j}]$	(d) $[I]^-$
64.	$H_2S$ is more acidic than $H_2O$	, due to [BVP 2004	] 2.	A simple example of a coordin	nate covalent bond is exhibited by
	(a) $O$ is more electronegative	than S		(a) $C_2H_2$	(b) $H_2SO_4$
	(b) $O-H$ bond is stronger the	han $S - H$ bond		(-) $NH$	(1) HCl
	(c) $O - H$ bond is weaker that	n <i>S</i> – <i>H</i> bond		(c) $NH_3$	(d) HCl
65	(d) None of these Which of the following has covale	unt hand	3.	The bond that exists between	$NH_3$ and $BF_3$ is called
0.3.	which of the following has covar	[AFMC 1988; DCE 2004	]		[AFMC 1982; MP PMT 1985; MNR 1994
	(a) $Na_2S$	(b) $AlCl_3$		(a) Electrovalent	(b) Covalent
	(c) NaH	(d) $MgCl_2$		(c) Coordinate	(d) Hydrogen
66.	The following element forms a r atoms	nolecule with eight its own weigh [MHCET 2004	t <b>4.</b> ]	Which of the following does r	oot have a coordinate bond [MADT Bihar 1984]
	(a) Si	(b) <i>S</i>		(a) $SO_2$	(b) $HNO_3$
	(c) Cl	(d) <i>P</i>		(c) $H_2 SO_2$	(d) $HNO_{2}$
67.	In $H_2O_2$ , the two oxygen atoms	have	5.	Coordinate covalent compour	ds are formed by
	(a) Electrovalent bond (c) Coordinate bond	(b) Covalent bond (d) No bond		compound consider compound	[CPMT 1990, 94]
68.	Carbon has a valency of 2 in C	$CO$ and 4 in $CO_{2}$ and $CH_{2}$ . It	s	(a) Transfer of electrons	(b) Sharing of electrons
	valency in acetylene $(C_{-}H_{-})$ is	[NCERT 107]	1	(c) Donation of electrons	(d) None of these process
	(a) $1$	(b) 2	<sup>,</sup> 6.	In the coordinate valency	[CPMT 1989]
	(c) 3	(d) 4		(a) Electrons are equally sha	red by the atoms
69.	Number of electrons in the valen molecule are	ce orbit of nitrogen in an ammonia [MH CET 2004]	a ]	(c) Hydrogen bond is forme	d

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	(d) None of the above				[DPM1	ſ 1985]
7.	Which of the following c	ontains a coordinate covalent bond		(a) $BF_3$	(b) <i>CCl</i> <sub>4</sub>	•
		[MNR 1990; 11T	1986]	(c) $BeCl_2$	(d) All of these	
	(a) $N_2 O_5$	(b) $BaCl_2$	3.	Which molecule has the	largest dipole moment	
	(c) HCl	(d) $H_2O$			[CPM	T 1991]
8.	A coordinate bond is for $()$	med when an atom in a molecule has	[	CB\$E)PMTH992]	(b) <i>HI</i>	
	(a) Electric charge on n (b) All its valency electr	rons shared		(c) <i>HBr</i> The unequal charing of	(d) HF	atoms
	(c) A single unshared e	lectron	4.	in a molecule causes	EAMCET	асонія Г <b>1986</b> ]
	(d) One or more unsha	red electron pair		(a) Dipole		
9.	Which has a coordinate l	oond [RPMT	1997]	(b) Radical formation		
	(a) $SO_3^{2-}$	(b) $CH_4$		(c) Covalent bond (d) Decomposition of	nolecule	
	(c) $CO_2$	(d) $NH_3$	5.	Which of the following	will show least dipole character	
10.	The compound containin	g co-ordinate bond is	0.		[NCERT 1975; Kurukshetra CEI	E 1998]
		[AFMC 1999; Pb. CET	2002]	(a) Water	(b) Ethanol	
	(a) $O_3$	(b) $SO_3$		(c) Ethane	(d) Ether	
	(c) $H_2 SO_4$	(d) All of these	6.	Which of the following	molecules will show dipole moment	
11.	The number of dative bo	nds in sulphuric acid molecules is	2002]	(a) Methane	[NCERT 1972, 74; DPM]	° 1985]
	(a) 0	(b) 1	2002]	(c) Chloroform	(d) Carbon dioxide	
	(c) 2	(d) 4	7.	Which of the following	compounds possesses the dipole momen	nt[NCERT 1978;
12.	Which of the following c	ompounds has coordinate (dative) bond	3	(a) W <b>RET 2003</b> ]	(b) Boron trifluoride	
	(a) $CH_3NC$	(b) $CH_3OH$		(c) Benzene	(d) Carbon tetrachloride	
	(c) $CH_3Cl$	(d) $NH_3$	8.	Which bond angle $\theta$ w	ould result in the maximum dipole main of the second	oment
13.	The structure of orthoph	osphoric acid is [KCET	2003]	(-) $Q = QQ^{0}$	(L) $0 = 120^{\circ}$	
	<i>O</i>	Н		(a) $\theta = 90$	(b) $\theta = 120$	
	(a) $H - O - P - O -$	$H$ (b) $O \leftarrow P - O - H$		(c) $\theta = 150^{\circ}$ Which of the following	(d) $\theta = 180^{\circ}$	FCRSE DMT 200
			G <sup>y</sup> .	(a) $BE_2$	(b) SiF.	
				(c) $\Sigma F_{3}$		
	Н	Н	10	(c) $SF_4$	(u) $\Lambda er_4$	
	Н		10.	Carbon tetrachionde na	[11T 1982, 83; MP PMT 1985, 91; EAMCE	Г 1988;
	(c) $O \leftarrow P - O - H$	(d) $H - O - P \neq Q$		( ) _ <b>.</b>	AML	l 1999]
	H			(a) Its planar structure	e Iral atmuatura	
14	What is the nature	of the bond between B and (	) in	(c) Similar sizes of car	bon and chlorine atoms	
14.	$(C_2H_5)_2OBH_2$	Orissa JEE	2003]	(d) Similar electron af	inities of carbon and chlorine	
	(a) Covalent	(b) Co-ordinate covalent	-, 11.	The molecule which h	as the largest dipole moment among	st the
	(c) Ionic bond	(d) Banana shaped bond		following		( 1983]
15.	Sulphuric acid provides	a example of		(a) $CH_4$	(b) $CHCl_3$	
		[Kerala CET (Med.)	2002]	(c) $CCl_4$	(d) CHI <sub>3</sub>	
	(a) Co-ordinate bonds (b) Non-covalent compo	h	12.	Positive dipole moment	is present in	` 2000]
	(c) Covalent and co-ord	linate bond		(a) $CCl_{4}$	(b) $C_{\epsilon}H_{\epsilon}$	2000]
	(d) Non-covalent ion	<b>J</b>		$(c) BF_{-}$	(d) $HE$	
	Din	ala mamant	12	The polarity of a covale	at hand between two stoms depends up	non
				(a) Atomic size	(b) Electronegativity	
1.	Which molecules has zer	o dipole moment		(c) lonic size	(d) None of the above	
		AIIMS 1980, 82, 91; Roorkee 2000; MH CET	2001] 14.	Pick out the molecule w	hich has zero dipole moment	[ 1000 <sup>1</sup>
	(a) $H_2O$	(b) $CO_2$		(a) $NH$	נראז 1989; EAMCET 1993; MP PM1 (h) <i>H O</i>	1999]
•	(c) $HF$	(d) $HBr$		(a)  PC'	$(0)$ $H_2O$	
4.	mule following which of	ne nave zero cipole moment		(c) $DCl_3$	(a) $SO_2$	

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15.	Zero dipole moment is prese	nt in [DPMT 1986; IIT 1987]		(c) Sulphur dioxide	(d) Water	<b>^</b>
	(a) $NH_3$	(b) $H_2O$	28.	$N_2$ is less reactive than $CN$	<sup>7</sup> due to <b>[UPSEAT</b> :	2003]
	(c) <i>cis</i> 1, 2-dichloroethene	(d) <i>trans</i> 1, 2-dichloroethene		(a) Presence of more electr	ons in orbitals	
16.	Which of the following is the	e most polar [AFMC 1988]		(b) Absence of dipole mom	ent	()
	(a) $CCl_4$	(b) $CHCl_3$		(c) Difference in spin quan	tum no	
	(c) $CH_3OH$	(d) $CH_3Cl$		(d) None of these		
17.	Which one has minimum (ne	early zero) dipole moment [IIT Screening 1994; CBSE PMT 1996]	29.	In a polar molecule, the ion inter ionic distance is one Å	nic charge is 4.8× unit, then the dipole	$\times 10^{-10}$ e.s.u. If the moment is
	(a) Butene-1	(b) $cis$ butene-2		(a) 41.8 debye	(b) 4.18 deby	'e
18	(c) <i>trans</i> butene-2 Which one of the following it	(a) 2-metnyi-i-propene		(c) 4.8 debye	(d) 0.48 deby	ye
10.	which one of the following is	[RPMT 1997; EAMCET 1988; MNR 1991]	30.	Which of the following is a p	olar compound	
	(a) $CCl_4$	(b) $CH_3Cl$				[Pb. CET 2000]
	(c) $CH_{\alpha}F$	(d) CHCl <sub>2</sub>		(a) HCl	(b) $H_2Se$	
10	Which of the following mo	lecules does not possess a permanent		(c) <i>CH</i> <sub>4</sub>	(d) <i>HI</i>	
.9.	dipole moment	[CBSE PMT 1994]	31.	Which of the following has n	o dipole moment	
	(a) $H_2S$	(b) $SO_2$				[DCE 2002
	$(c)$ $CS_{c}$	$(d) SO_2$		(a) $CO_2$	(b) $SO_3$	
20	Which of the following has $z$	ero dipole moment		$(c)$ $O_{c}$	(d) $H_{a}O$	
20.	which of the following has z	[CPMT 1997; AFMC 1998; CBSE PMT 2001]		(c) $(c)$	(d) 1120	
	(a) $CH_2Cl_2$	(b) <i>CH</i> <sub>4</sub>	32.	which of the following is not	n-polar	[DCE 2002]
	(c) $NH_2$	(d) $PH_2$		(a) $PCl_5$	(b) $PCl_3$	
21	Fluorine is more electrones	ative than either boron or phosphorus		(c) $SF_6$	(d) <i>IF</i> <sub>7</sub>	
2	What conclusion can be dr	rawn from the fact that $BF_2$ has no	33.	Identify the non-polar mole	cule in the set of	compounds given
	dipole moment but PF, do	es s		HCl, HF, H <sub>2</sub> , HBr		[UPSEAT 2004]
	alpole moment bat 113 do	[Ph. PMT 1998]	()	(a) $H_2$	(b) <i>HCl</i>	
	(a) $BF_2$ is not spherically s	symmetrical but $PF_2$ is				
	(b) <i>BE</i> melocule must be	linear		(c) $HF, HBr$	(d) HBr	
	(b) $DT_3$ molecule must be		34.	Dipole moment is shown by		[IIT 1986]
	(c) The atomic radius of $P$	is larger than the atomic radius of B		(a) 1, 4-dichlorobenzene		
	(d) The $BF_3$ molecule mu	ist be planar triangular		(b) <i>cis</i> 1, 2-dichloroethene		
22.	Which molecule does not sho	ow zero dipole moment		(c) <i>trans</i> 1, 2-dichloroether	ıe	
	(a) $BE_{-}$	(b) <i>NH</i> .		(d) <i>trans</i> 1, 2-dichloro-2-pe	entene	
	(a) $DI_3$		35.	If <i>HCl</i> molecule is completel	y polarized, so expe	cted value of dipole
	(c) $CCl_4$	(d) $CH_4$		1.03D. Calculate the percenta	ge ionic character	[Kerala CET 2005]
23.	The dipole moment of <i>HL</i>	Br is $1.6 \times 10^{-30}$ cm and interatomic		(a) 17	(b) 83	
	spacing is 1 <i>A</i> . The % ionic ch	haracter of HBr is		(c) 50	(d) Zero	
	(a) 7	(b) 10		(e) 90		
	(c) 15	(d) 27	_	<b>.</b>		
24.	Non-polar solvent is	[RPET 2000]		Polarisation	and Fajan's r	ule
	(a) Dimethyl sulphoxide	(b) Carbon tetrachloride	_		1 1 1	
05	(c) Ammonia	(d) Ethyl alcohol	1.	$BF_3$ and $NF_3$ both molecu	les are covalent, but	$BF_3$ is non-polar
25.	which shows the least dipole	[UPSEAT 2001: DPMT 1982]		and $NF_3$ is polar. Its reasor	ı is	
	(a) $CCl_{4}$	(b) $CHCl_2$			[CPA	NT 1989; NCERT 1980
		(d) CH COCH		(a) In uncombined state bo	ron is metal and nit	rogen is gas
<b>.</b>	$(c)  CH_3 CH_2 OH$			(b) $B-F$ bond has no dip	oole moment wherea	as $N-F$ bond has
20.	which molecule has zero dip	(L) 4-1		dipole moment		
	(a) $H_2 U$	(D) Agi		(c) The size of boron atom	is smaller than nitro	ogen
	(c) $PbSO_4$	(d) <i>HBr</i>		(d) $BF_3$ is planar whereas	$NF_3$ is pyramidal	
27.	The dipole moment is zero f	or the molecule	2.	Which one is polar molecule	among the following	g
	(a) Ammonia	[III 1989; MP PMT 2002] (b) Boron trifluoride		(a) $CO_2$	(b) <i>CCl</i> <sup>4</sup>	
					. / 4	

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					Chei	mical Bonding 107	UNIVERSAL SELF SCORER
	(c) $H_2O$ (d	I) $CH_4$		(c)	Na <sup>+</sup>	(d) $Ca^{2+}$	
3.	If the electron pair forming a bond b	between two atoms A and B is	15.	Max	imum covalent characte	r is associated with the co	ompound [RPMT 1999]
	not in the centre, then the bond is	[A11MS 1984]		(a)	NaI	(b) $MgI_2$	
	(a) Single bond (b	o) Polar bond		(c)	AlCl <sub>3</sub>	(d) $AlI_3$	
	(c) Non-polar bond (d	I) $\pi$ bond	16.	Pola	risibility of halide ions in	ncreases in the order	[DCE 1000]
4.	Which of the following liquids is r electrostatic field	not deflected by a non-uniform [NCERT 1978]		(a)	$F^-, I^-, Br^-, Cl^-$	(b) $Cl^{-}, Br^{-}, L$	[DCE 1999] I <sup>-</sup> , F <sup>-</sup>
	(a) Water (b	b) Chloroform		(c)	$I^{-}, Br^{-}, Cl^{-}, F^{-}$	(d) $F^-, Cl^-, B_1$	$r^-, I^-$
-	(c) Nitrobenzene (d	I) Hexane	17.	Acco	ording to Fajan's rule, co	ovalent bond is favoured l	у
5.	which of the following is non-polar $(x) = H S$ (b)	NaCl		()	1 1 11		[AIIMS 1999]
				(a) (b)	Large cation and small	anion	
	(c) $Cl_2$ (d	$H_2 SO_4$		(c)	Small cation and large	anion	
6.	Polarization is the distortion of t	the shape of an anion by an		(d)	Small cation and small	anion	
	correct	[NCERT 1982]	18.	Whi	ch of the following state	ements is correct	[AMU 1999]
	(a) Maximum polarization is brou	ight about by a cation of high		(a)	$SF_4$ is polar and non-	reactive	
	charge			(b)	$SF_6$ is non-polar and $\gamma$	very reactive	
	(b) Minimum polarization is broug low radius	ht about by a cation of		(c)	$SF_6$ is a strong fluoring	nating agent	
	(c) A large cation is likely to b	oring about a large degree of		(d)	$SF_4$ is prepared by flu	orinating SCl <sub>2</sub> with Na	ıF
	polarization		19.	Cho	ose the correct statemer	nt	[RPMT 2000]
-	(d) A small amon is likely to under $P$	go a large degree of polarization $C_{i}$ at a set $C_{i}$ and $C$		(a)	Amino polarisation is cation	s more pronounced by	highly charged
7.	he	$\begin{bmatrix} \mathbf{MP} \ \mathbf{PMT} \ 1087 \end{bmatrix}$		(b)	Small cation has minim	um capacity to polarise an	anion.
	(a) lonic with no covalent characte	r	(	(c)	Small anion has maxim	num polarizability	
	(b) Covalent with some ionic chara	octer		(d)	None of these		
	(c) Covalent with no ionic characte	er	20.	The	<i>ICl</i> molecule is		[DPMT 2001]
-	(d) Ionic with some metallic charac	eter		(a) (b)	Purely covalent		
8.	Two electrons of one atom A and t are utilized to form a compound AB	two electrons of another atom $B$ . This is an example of		(c)	Polar with negative end	d on iodine	
	(a) Polar covalent bond (b	) Non-polar covalent bond		(d)	Polar with negative end	d on chlorine	
	(c) Polar bond (d	l) Dative bond	21.	Whi	ch of the following is a	polar compound	[AIIMS 2001]
9.	In which of the following molecule is	s the covalent bond most polar [A	MU 1985; i	MP PE	T 2001]	(b) HCI	
	(a) <i>HI</i> (b	b) HBr	22	(c) wh:	$m_{3}$	(d) $\Pi_2 SO_4$	
	(c) HCl (d	I) $H_2$	22.	WIII	ch of the following has:		[MP PMT 2002]
10.	Amongst $ClF_3$ , $BF_3$ and $NH_3$	molecules the one with non-		(a)	ClF	(b) <i>PCl</i> <sub>3</sub>	
	planar geometry is	[MP PMT 1999]		(c)	$SiF_{4}$	(d) $CFCl_3$	
	(a) $ClF_3$ (b	b) $NH_3$	23.	Whi	ch of the following com	pounds has least dipole n	noment
	(c) <i>BF</i> <sub>3</sub> (d	l) None of these	-0-		<b>3</b>	r · · · · · · · · · · · · · · · · · ·	[RPET 2003]
11.	Which of the following possesses hig	phest melting point		(a)	$PH_3$	(b) CHCl <sub>3</sub>	
	C	[CPMT 1999]		(c)	NH <sub>3</sub>	(d) <i>BF</i> <sub>3</sub>	
	(a) Chlorobenzene (b	<i>o</i> -dichlorobenzene	24.	Paul	ing's electronegativity	values for elements	are useful in
10	(c) <i>m</i> -dichlorobenzene (d	l) <i>p</i> -dichlorobenzene		pred	licting		[UPSEAT 2004]
12.	The polar molecule among the follow	Ving is		(a)	Polarity of bonds in me	olecules	
				(b)	Position of elements in	electrochemical series	
				(c) (d)	Dipole moment of vari	ous molecules	
	(c) $CH_2Cl_2$ (d	$CH_2 = CH_2$	25.	Amo	ongst LiCl, RbCl. BeCl.	$_{2}$ and $MgCl_{2}$ the com	oounds with the
13.	Which of the following have both po	olar and non-polar bonds		grea	[AIIMS 1997] test and the least ionic	character, respectively, are	e [UPSEAT 2002]
	(a) $C_2H_6$ (b	$IVH_4 Cl$		(a)	LiCl and RbCl	(b) <i>RbCl</i> and <i>Be</i>	$Cl_2$
	(c) <i>HCl</i> (d	I) $AlCl_3$		(c)	RbCl and MoCl.	(d) MoCl and	BeCl
14.	Which of the following has a high po	olarising power	26	Bon	d polarity of distomic m	$(u) m_g c_{i_2}$ and $u_{i_3}$	
	$(2) Ma^{2+}$ (1)	[CE1 rune 1998]	20.	5011	a polarity of ulatoffild m	OCCUR IS DECAUSE OF	[UPSEAT 2002]
		$p_j = \Delta t$					

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SELF S	108 Chemical Bonding			
	<ul> <li>(a) Difference in electron affinities of the two atoms</li> <li>(b) Difference in electron affinities of the two atoms</li> </ul>		(b) Sidewise overlap of orbitals takes place	
	(b) Difference in electronegativities of the two atoms		(c) End to end overlap of orbitals takes place	
	(d) All of these	11.	The number of sigma and pi bonds in 1-butene-3-yne are	
			[IIT 198	<b>89</b> ]
	Overlaping- $\sigma$ and $\pi$ - bonds		(a) 5 sigma and 5 pi (b) 7 sigma and 3 pi (c) 8 sigma and 2 pi (d) 6 sigma and 4 pi	
1.	Triple bond in ethyne is formed from	12.	The most acidic compound among the following is	
	[MP PMT 1990; NCERT 1979; EAMCET 1978; AMU 1985;		[MP PET 199	<del>9</del> 3]
	CPMT 1988; MADT Bihar 1982; MH CET 2000]		(a) $CH_3CH_2OH$ (b) $C_6H_5OH$	
	(a) Three sigma bonds		(c) $CH_3COOH$ (d) $CH_3CH_2CH_2OH$	
	(c) One sigma and two ni bonds	13.	Which of the following is not correct [CBSE PMT 199	90]
	(d) Two sigma and one pi bond		(a) A sigma bond is weaker than $\pi$ bond	
2.	The bond in the formation of fluorine molecule will be		(b) A sigma bond is stronger than $\pi$ bond	
	[MP PMT 1987]		(c) A double bond is stronger than a single bond	
	(a) Due to $s-s$ overlapping		(d) A double bond is shorter than a single bond	
	(b) Due to $s - p$ overlapping	14.	(a) Maximum overlap	
	(c) Due to $p-p$ overlapping		(c) Overlapping not done (d) None of them	
	(d) Due to hybridization	15.	The $p - p$ orbital overlapping is present in the following molecul	le
3.	Which type of overlapping results the formation of a $\pi$ bond	-	(a) Hydrogen (b) Hydrogen bromide	
	[DPMT 1981]		(c) Hydrogen chloride (d) Chlorine	
	(a) Axial overlapping of $s-s$ orbitals	16.	In $N_2$ molecule, the atoms are bonded by	
	(b) Lateral overlapping of $p-p$ orbitals		[MP PET 1996; UPSEAT 20	001]
	(c) Axial overlapping of $p-p$ orbitals		(a) One $\sigma$ . Two $\pi$ (b) One $\sigma$ . One $\pi$	-
	(d) Axial overlapping of $s - p$ orbitals	(	(c) Two $\sigma$ One $\pi$ (d) Three $\sigma$ bonds	
4.	The number and type of bonds between two carbon atoms in	17	In which of following there exists a $p\pi - d\pi$ bonding	
	calcium carbide are [AlEEE 2005]	(")	In which of following there exists a <i>pn un</i> boliding	ທາໄ
	(a) One signa, one pi (b) One signa, two pi		(a) Diamond (b) Graphite	1
5.	In a double bond connecting two atoms, there is a sharing of		(c) Dimethyl amine (d) Trisilylamine	
	[CPMT 1977, 80, 81; NCERT 1975;	18.	Number of bonds in $SO_2$ [DCE 20]	001]
	Bihar MEE 1980; MP PET 1999]		(a) Two $\sigma$ and two $\sigma$	•
	(a) 2 electrons (b) 1 electron		(a) Two o and two $\pi$	
	(c) 4 electrons (d) All electrons		(b) Two $\sigma$ and one $\pi$	
6.	Strongest bond is [DPMT 1990]		(c) Two $\sigma$ , two $\pi$ and one lone pair	
	(a) $C-C$ (b) $C=C$		(d) None of these	
	(c) $C \equiv C$ (d) All are equally strong	19.	Which of the following has $p\pi - d\pi$ bonding [CBSE 20]	02j
7.	$\pi$ bond is formed [JIPMER 2002]		(a) $NO_3^-$ (b) $CO_3^{-2}$	
-	(a) By overlapping of atomic orbitals on the axis of nuclei			
-	(a) by overlapping of acomic orbitals of metals of meter		(c) $BO_{-3}^{-3}$ (d) $SO_{-2}^{-2}$	
-	<ul> <li>(b) By mutual sharing of pi electron</li> <li>(c) Dividual sharing of pi electron</li> </ul>		(c) $BO_3^{-3}$ (d) $SO_3^{-2}$	
-	<ul> <li>(b) By mutual sharing of pi electron</li> <li>(c) By sidewise overlapping of half filled <i>p</i>-orbitals</li> <li>(d) D = 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1</li></ul>	20.	(c) $BO_3^{-3}$ (d) $SO_3^{-2}$ Number of sigma bonds in $P_4O_{10}$ is [AIEEE 2002]	
0	<ul> <li>(d) By overlapping of atomic orbitals on the date of matter</li> <li>(b) By mutual sharing of pi electron</li> <li>(c) By sidewise overlapping of half filled <i>p</i>-orbitals</li> <li>(d) By overlapping of <i>s</i>-orbitals with <i>p</i>-orbitals</li> </ul>	20.	(c) $BO_3^{-3}$ (d) $SO_3^{-2}$ Number of sigma bonds in $P_4O_{10}$ is [AIEEE 2002] (a) 6 (b) 7	
8.	<ul> <li>(d) By overlapping of atomic of orals on atomic of nation</li> <li>(b) By mutual sharing of pi electron</li> <li>(c) By sidewise overlapping of half filled <i>p</i>-orbitals</li> <li>(d) By overlapping of <i>s</i>-orbitals with <i>p</i>-orbitals</li> <li>The double bond between the two carbon atoms in ethylene consists of INCERT 1981: EAMCET 19791</li> </ul>	20.	(c) $BO_3^{-3}$ (d) $SO_3^{-2}$ Number of sigma bonds in $P_4O_{10}$ is [AIEEE 2002]         (a) 6       (b) 7         (c) 17       (d) 16	
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8. 9.	(b) By mutual sharing of pi electron (c) By sidewise overlapping of half filled <i>p</i> -orbitals (d) By overlapping of <i>s</i> -orbitals with <i>p</i> -orbitals (d) By overlapping of <i>s</i> -orbitals with <i>p</i> -orbitals The double bond between the two carbon atoms in ethylene consists of [NCERT 1981; EAMCET 1979] (a) Two sigma bonds at right angles to each other (b) One sigma bond and one pi bond (c) Two pi bonds at right angles to each other (d) Two pi bonds at an angle of $60^{\circ}$ to each other In the series ethane, ethylene and acetylene, the $C - H$ bond energy is [NCERT 1977] (a) The same in all the three compounds (b) Greatest in ethane	20. 1. 2.	(c) $BO_3^{-3}$ (d) $SO_3^{-2}$ Number of sigma bonds in $P_4O_{10}$ is [AIEEE 2002](a) 6(b) 7(c) 17(d) 16HybridisationWhich molecule is not linear(c) $BeF_2$ (b) $BeH_2$ (a) $BeF_2$ (b) $BeH_2$ (c) $CO_2$ (d) $H_2O$ The bond angle in water molecule is nearly or Directed bonds water forms an angle of[NCERT 1980; EAMCET 1981; MNR 1983, 1	94] in 85;
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					Chemical Bonding 109	UNIVERSAL SELF SCORER
	(c) $109^{\circ}28'$	(d) 104°30'	12.	The mode of hybridis	sation of carbon in $CO_2$ is	[CPMT 1991]
3.	The central atom in a molecu molecule will be [ <b>MP PMT 198</b> 7	le is in $sp^2$ hybrid state. The shape of <b>7: CRSE PMT 1989</b> ]		(a) <i>sp</i>	(b) $sp^2$	$\mathbf{O}$
	(a) Pyramidal	(b) Tetrahedral		(c) $sp^3$	(d) None of these	
	(c) Octahedral	(d) Trigonal planar	13.	In which of the follow	wing the central atom does not use	e sp <sup>3</sup> hybrid
4.	Which molecule is linear	[AID DAAT 1094, 11T 1090, 99, EAMCET 1000.		orbitals in its bonding	g	[MNR 1992]
		CBSE PMT 1992; MP PET 1995; RPMT 1997]		(a) $BeF_3^-$	(b) $OH_3^+$	
	(a) <i>NO</i> <sub>2</sub>	(b) <i>ClO</i> <sub>2</sub>		(c) $NH_2^{-}$	(d) $NF_3$	
	(c) $CO_2$	(d) $H_2S$	и	$X_{\rho}F_{\tau}$ involves hybri	idisation	
5.	Which of the following molect	ules has trigonal planer geometry [CBSE	PMT 2005]			[51111 1990]
	(a) <i>IF</i> <sub>3</sub>	(b) PCl <sub>3</sub>		(a) $sp^3$	(b) $sp^3d$	
	(c) $NH_3$	(d) <i>BF</i> <sub>3</sub>		(c) $sp^3d^2$	(d) None of these	
6	A $sn^3$ hybridized orbital con	tains	15.	Which of the followir	ng hybridisation results in non-plar	nar orbitals
0.	in sp hybridized orbital con	[DPMT 1984: BHU 1985: CPMT 1976]		(a) $sp^3$	(b) $dsp^2$	
	$\sim$ 1 .			(a) $\sin^2$	(d) sn	
	(a) $\frac{-s}{4}$ - character	(b) $\frac{-s}{2}$ - character	16	(c) sp	$(\mathbf{u})  \mathbf{s}\mathbf{p}$	
	$(a) = \frac{2}{3}$ subarrates	(d) <sup>3</sup> s character	10.	Octanedral molecular	snape exists in hybridisation	DPMT 1990]
	$\begin{pmatrix} c \\ 3 \end{pmatrix}$ = character	$\begin{pmatrix} d \end{pmatrix} = \frac{3}{4} = \frac{3}{4}$		$(a)$ $sn^3d$	(b) $sn^3d^2$	[]
7.	Structure of ammonia is			(a) $sp$ $a$	(b) <i>sp</i> u	
		[MP PMT 1987, 89, 91; CPMT 1975, 82; RPMT 1999: IIPMFR 2002]		(c) $sp^{s}d^{s}$	(d) None of these	
	(a) Trigonal	(b) Tetrahedral	17.	The electronic structu	ure of molecule $OF_2$ is a hybrid of	of
	(c) Pyramidal	(d) Trigonal pyramidal		(a) <i>sp</i>	(b) $sp^2$	
8.	The bond angle in ethylene is	[CPMT 1987]		(c) $sp^3$	(d) $sd^3$	
	(a) $180^{\circ}$	(b) $120^{\circ}$	10	Percentage of a share	natar in an <sup>3</sup> hubrid arhital ia	
	(c) $109^{\circ}$	(d) 90°	10.	(a) 25	(b) 50	
9.	Compound formed by $sp^3d$	hybridization will have structure		(a) $23$ (c) 66	(d) 75	
		[BHU 1982; RPMT 1999]	19.	Shape of $XeF_4$ mole	ecule is	
	(a) Planar	(b) Pyramidal			[BHU 1987; AFMC 1992; (	CET Pune 1998;
	(c) Angular	(d) Trigonal bipyramidal			Roorkee Qualifying 19	98; DCE 2002]
10.	Which of the following forn bonding capacity of the atom	iula does not correctly represent the involved		(a) Linear	(b) Pyramidal	
	<u> </u>	[CBSE PMT 1990]	20	(c) Tetrahedral	(d) Square planar	ia mavimum
	$\begin{bmatrix} H \end{bmatrix}$		20.	() $-\pi^2$		
	(a) $H - P - H$	$(\mathbf{b})$ $F$ $F$		(a) <i>sp</i> -	(b) <i>sp</i>	
				(c) $sp^3$	(d) $dsp^2$	
			21.	The $C-H$ bond dis	tance is the longest in	[MNR 1990]
	0			(a) $C_2H_2$	(b) $C_2 H_4$	
	(c) $0 \leftarrow N$	H - C = C		(c) $C_2H_4Br_2$	(d) $C_6 H_6$	
		0-н	22.	The nature of hybridi	ization in $CH_2Cl - CH_2Cl$ for	carbon is
n.	Which of the following statem	ent is not correct		(a) sn	(b) $sn^2$	
	(a) Hybridization is the mi	xing of atomic orbitals prior to their			(0) $sp$	
	combining into molecula	r orbitals		(c) $sp^3$	(d) $sp^2d$	
	(b) $sp^2$ hybrid orbitals are	formed from two $p$ atomic orbitals	23.	Shape of methane mo	olecule is	[MNR 1983]
	and one <i>s</i> atomic orbita	1		(a) retranedral	(d) Square planer	
	(c) $d^2 s p^3$ hybrid orbitals a regular octahedron	are directed towards the corners of a	24.	Which one amongst	t the following possesses an <i>s</i> <sub>1</sub>	bybridized
	(d) den <sup>3</sup> hubrid arbitale	all at $90^{\circ}$ to one another		(a) $CH = CC^{\dagger}$	е [Сі - <i>СН – СН</i>	BSE PMT 1989]
	u) usp hybrid orbitals are			(d) $CH_2 = C.Cl$ -	$-CH - CH_2$	

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	(b) $C.Cl_2 = C.Cl_2$		35.	In the following molecule,	the two carbon atoms marked by asterisk
	(c) $CH_2 = C = CH_2$			(*) possess the follo	wing type of hybridized orbitals
	(d) $CH_2 = CH - CH = C$	CH 2		$H_3C - C \equiv C - CH_3$	[NCERT 1984]
25.	Which of the following is the	correct electronic formula of chlorine		(a) $sp^3$ orbital	(b) $sp^2$ orbital
	molecule	[CPMT 1971]	_	(c) <i>sp</i> orbital	(d) <i>s</i> orbital
	(a) $\cdot Cl \cdot Cl \cdot$	(b) $\cdot Cl^{-} \cdot \cdot Cl^{+} \cdot$	36.	The bond angle in carbon t	MNR 1081- MP PMT 1087
	(u) · · · · · · · · · · · · · · · · · · ·			(a) $90^{\circ}$	(b) -109°
	$(c)  \cdot Cl \cdot Cl$	$(d)  \cdot  Cl  Cl$		(a) $120^{\circ}$	(b) $10^{\circ}$
	$(\mathbf{c})$	(u) · · · · · · · · · · ·	37.	When two pairs of electron	s are shared, bond is
26.	In $XeF_4$ hybridization is			•	[MNR 1979]
	(a) $sp^3d^2$	(b) $sp^3$		(a) Single covalent bond	(b) Double covalent bond
	(-) $an^3 d$	(1) $an^2 d$	- 9	(c) Dative bond	(d) Triple bond
	(c) sp a	(a) sp a	38.	The nature of hydridization	[FAMCET 1082]
27.	In <i>HCHO</i> , ' <i>C</i> " has hybridize	ation [AIIMS 1987]		(a) sn	(b) $sn^2$
	(a) <i>sp</i>	(b) $sp^2$		(a) $sp$	
	(c) $sp^3$	(d) All the above		(c) $sp$	(d) $sp^{-}d$
28.	Which has the shortest $C - C$	C bond length	39.	which one of the following $\Omega \Omega^{o}$	ig compounds has bond angle as nearly
		[NCERT 1982; CPMT 1989]		(a) $NH_{2}$	(b) $H_{2}S$
	(a) $C_2H_5OH$	(b) $C_2 H_6$			$(\mathbf{c})  \mathbf{f}_{2} = \mathbf{c}$
	(c) $C_2 H_2$	(d) $C_2 H_4$	40	In other the head angle (s	$(\mathbf{u}) = \mathbf{c} \mathbf{n}_4$
29.	The hybridization of $Ag$ in t	he linear complex $\left[Ag(NH_{2})_{2}\right]^{+}$ is	40.	CPMT 1985: BHU 1981	[CPMT 1976; AMU 1984; MP PMT 1985]
	$()$ $L^2$		(	(a) $109^{\circ}28'$	(b) 120°
	(a) asp	(b) <i>sp</i>		(c) $180^{\circ}$	(d) Different
	(c) $sp^2$	(d) $sp^3$	41.	Structure formula of $H_2 O$	0 <sub>2</sub> is [CPMT 1993]
30.	Experiment shows that $H_2O$	has a dipole moment while $CO_2$ has		H .	
	not. Point out the structures v	which best illustrate these facts [DPMT	1984; NC	(a) $O \to O$	
	(a) $O = C = O; H$	(b) $O = C = O; H - O - H$			
	(c) <i>C</i> ; <i>H</i> – <i>H</i> –	O (d) $O$ $H$		(b) $\Pi = O = O = \Pi$ (str	raignt line)
	õ õ	C=O; O-H		(c) $Q = Q$	
31.	Which species do not have <i>sp</i>	<sup>3</sup> hybridization		H	
		[DPMT 1985]		Where $H = 0 = 0 =$	$\langle Q - Q - H' = 101.5^{\circ}$ and all the four
	(a) Ammonia	(b) Methane		atoms are in the same plan	e
22	(c) Water	(d) Carbon dioxide		Ħ,	
34.	(a) Low energy	(b) Same energy		(d) $Q - O$	
	(c) High energy	(d) None of these		Ĥ	
33.	The compound 1, 2-butadiene	has		Where $\angle H - O - O = \angle$	$\angle O - O - H' = 97^{\circ}$ and the angle
	(a) Only sp hybridized carb	[11T 1983; MP PMT 1996]		between $H - O - O$ plan	e and $O - O - H'$ plane is $101^o$
	(1) O 1 $\operatorname{sp}^2 1$ 1 1 1 $\operatorname{sp}^2 1$		42.	Number of shared electro	ons in between carbon-carbon atoms in
	(b) Only $sp$ hybridized car			ethylene molecule is $(a) = 2$	[MADT Bihar 1983] (b) 4
	(c) Both $sp$ and $sp^2$ hybrid	ized carbon atoms		(c) 6	(d) 3
	(d) $sp$ , $sp^2$ and $sp^3$ hybri	dized carbon atoms	43.	The structural for	mula of a compound is
34.	The number of unpaired elect	rons in $O_2$ molecule is		$CH_3 - CH = C = CH_2$	. The type of hybridization at the four
		[MNR 1983; Kerala PET 2002]		carbons from left to right a	re [CBSE PMT 1989]
	(a) $0$	(b) 1 (d) 3		(a) $sp^2$ , $sp$ , $sp^2$ , $sp^3$	(b) $sp^2$ , $sp^3$ , $sp^2$ , $sp$
	() 🛩	(u) <b>3</b>			

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	(c) $sp^3$ , $sp^2$ , $sp$ , $sp^2$	(d) $sp^3$ , $sp^2$ , $sp^2$ , $sp^2$	55.	In diborane, the H	$-B-H$ bond angle is $120^{\circ}$ . The second
44.	Acetate ion contains	[AMU 1983]		hybridization of boron is l	Ikely to be
	(a) One $C$ , $O$ single bond a	and one $C, O$ double bond		(a) sn	(b) $sn^2$
	(b) Two $C$ , $O$ single bond	s		(a) $sp$	$(\mathbf{b})$ sp
	(c) Two $C$ , $O$ double bond	s	-	(c) $sp^3$	(d) $dsp^2$
	(d) None of the above		56.	The number of shared pai	irs of electrons in propane is
45.	The two carbon atoms in ace	tylene are		(a) 2	(b) 4
		[AMU 1984; MADT Bihar 1982]		(c) 6	(d) 10
	(a) $sp^3$ hybridized	(b) $sp^2$ hybridized	57.	s-character in <i>sp</i> hybridis	sed orbitals are
	(c) <i>sp</i> hybridized	(d) Unhybridized		. 1	
46.	Among the following compou	inds which is planar in shape		(a) $\frac{1}{3}$	$(6) \frac{1}{2}$
		[AMU 1992]		(-) 1	(1) 2
	(a) Methane	(b) Acetylene (d) Isobutene		(c) $\frac{1}{4}$	(d) $\frac{1}{3}$
47.	In methane the bond angle is	(u) isobutene [AMU 1983]	58.	The two types of bonds p	resent in $B_2H_6$ are covalent and
	(a) $180^{\circ}$	(b) $90^{\circ}$			<b>[11T 199</b> 4
	(a) $100^{\circ}$	(b) $100^{\circ}$		(a) Three centre bond	(b) Hydrogen bond
	(c) 120	(d) 109		(c) Two centre bond	(d) None of the above $\bigcirc OCL$ is in the latent $\bigcirc$
48.	The angle between $sp^2$ orbit	als in ethylene is	59.	In the compound $CH_3$	$\bigcirc OCl$ , which type of orbitals have been in hand formation
		[BHU 1987, 95; AMU 1985]		used by the circled carbor	[MP PET 1994
	(a) 90°	(b) 120°		(a) $sp^3$	(b) $sp^2$
	(c) $180^{\circ}$	(d) $109.5^{\circ}$		(c) sp	$(\mathbf{d}) \mathbf{p}$
49.	The species in which the ce	ntral atom uses $sp^2$ hybrid orbitals in	60.	The correct order of the	$Q - Q$ bond length in $Q_2$ , $H_2Q_2$ and
	its bonding is	[IIT 1988]		$\theta_{\rm a}$ is	CRSE PMT 100
	(a) $PH_3$	(b) $NH_3$	$\sim$	(x)  0  x  0  x  H  0	(b) $O > H O > O$
	(c) $H_3C^+$	(d) $SbH_3$		(a) $O_2 > O_3 > \Pi_2 O_2$	$(0)  O_3 > H_2 O_2 > O_2$
50.	Carbon atoms in diamond	d are bonded to each other in a		(c) $H_2 O_2 > O_3 > O_2$	(d) $O_2 > H_2 O_2 > O_3$
	configuration	[CPMT 1981]	61.	The structure of $PF_5$ mol	lecule is
	(a) Tetrahedral	(b) Planar (d) Octabedral		(a) Tatrahadral	(h) Trigonal hingamidal
51.	Which of the following mol	ecules can central atom said to adopt		(c) Square planar	(d) Pentagonal bipyramidal
•	$sn^2$ hybridization	[CBSE PMT 1989: MP PET 1994]	62.	Which of the following hy	bridisation has maximum <i>s</i> -characters
	(a) $BeF_{-}$	(b) <i>BCL</i>		(a) $sp^3$	(b) $sp^2$
	(a) $DCI_2$	$(b)  D \in \mathbb{N}_3$		(c) <i>sp</i>	(d) None of these
	(c) $C_2 H_2$	$(\mathbf{d})  \mathbf{NH}_{3}$	63.	The $PCl_5$ molecule is a 1	result of the hybridisation of
52.	$\ln [Cu(NH_3)_4]SO_4, ;Cu$	has following hybridization		5	[MP PET 1995; DCE 2000; MP PMT 2002
	. 2	[A11MS 1988; UPSEAT 2001]		(a) $sp^2d^2$	(b) $sp^3d$
	(a) $dsp^2$	(b) $sp^3$		(a) and $(a)$	(d) $sn^2 d^3$
	(c) $sp^2$	(d) $sp^3d^2$	64	(c) spu Hybridisation involves	$(\mathbf{u})  sp  \mathbf{u}$
53.	The hybridization of carbo	n atoms in $C-C$ single bond of	04.	(a) Addition of an electro	on pair
	$HC \equiv C - CH = CH_2$ is	[11T 1991; MP PET 1995]		(b) Mixing up of atomic	orbitals
	(a) $sp^3 - sp^3$	(b) $sp^2 - sp^3$		(c) Removal of an electro	on pair
	(c) $sn - sn^2$	(d) $sn^3 - sn$	<b>6</b> -1	(d) Separation of orbitals	S
	(c) $sp$ $sp$	$\begin{array}{c} (1)  S_{P}  S_{P} \\ 3  1  1  C  1  1  C \\ \end{array}$	65.	(a) Tetrahedral	trioxide molecule is
54.	The compound in which C	uses <i>Sp</i> hybrids for bond formation		(c) Pyramidal	(d) Square planar
	+	ן פספי ייי <u>ן</u> +	66.	The shapes of $BCl_3$ , $PC$	$Cl_3$ and $ICl_3$ molecules are all
	(a) HCOOH	(b) $(NH_2)_2CO$		(a) Triangular	(b) Pyramidal
	$(c)$ $(NH_{a})_{a}^{+}COH_{a}H_{a}C^{\dagger}$	(d) $CH_{2}CHO$		(c) $T - shaped$	(d) All above are incorrect
		(4) 01130110	67.	In benzene molecule all C	C-C bond lengths are equal because

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	(a) All carbon atoms are equivalent			(a)	SnCl <sub>2</sub>	(b)	HCl	
	(b) All carbon atoms are $sp^2$ hybridised			(c)	<i>CO</i> .	(b)	HoCl.	
	(c) All $C - C$ bonds in benzene, have same o	rder	70	(c)	$co_2$	(u)	is true for a	
	(d) All $C - C$ bonds are single covalent bond		79.	(a)	All bonds are jonic	itements	is true for a	mmonium ion
68.	Which one is false in the following statements			(a) (b)	All bonds are coordinate	covalent		
		[MP PET 1997]		(c)	H atoms are situated at	the corr	ers of a sou	are
	(a) Each carbon in ethylene is in $sp^2$ hybridis	sation		(d)	H atoms are situated at	the corr	ers of a tetr	ahedron
	(b) Each carbon in acetylene is in $sp^3$ hybrid	isation	80.	The	bond angle in $sp^2$ hybrid	disation	is	[RPMT 1997]
	(c) Each carbon in benzene is in $sp^2$ hybridis	ation		(a)	180°	(b)	$120^{\circ}$	
	(d) Each carbon in ethane is in $sp^3$ hybridisa	tion		(c)	90°	(d)	109°2'	
69.	Out of the following hybrid orbitals, the one w	hich forms the bond	81.	The	correct order towards bor	nd angle	is	[RPMT 1997]
	at angle $120^o$ , is	[MP PMT 1997]		(2)	$sn < sn^2 < sn^3$	Ŭ		
	(a) $d^2 s p^3$ (b) $s p^3$			(a) (b)	sp < sp < sp $sp^2 < sp < sp^3$			
	(c) $sp^2$ (d) $sp$			(-)				
70.	As the $p$ – character increases, the bond ang	le in hybrid orbitals		(c)	$sp^{-} < sp^{-} < sp$		1 . 1	
	formed by $s$ and atomic orbitals [MP PMT 1997]		82	(d) The	Bond angle does not depe	of byb	iybridisation	magant about the
	(a) Decreases (b) Increases (c) Doubles (d) Remains	unchanged	02.	centr	ral atom in $BF_3$ is	or nyb		[IIT 1998; BHU 2001]
71	$sn^3$ hybridization leads to which shape of the	molecule			Lines (D	( <b>b</b> )	Trigonal al	$n^2$
<i>,</i>	sp hjohazation leads to which shape of the	[MP PET/PMT 1998]			Littear, sp	(0)	ringonai pia	2 <sup>2</sup>
	(a) Tetrahedron (b) Octahed	ron		(c)	Tetrahedral, sp <sup>3</sup>	(d)	Pyramidal,	sp <sup>3</sup>
	(c) Linear (d) Plane tri	angle	83.	ln gr	raphite, electrons are			[CBSE PMT 1997]
72.	Which of the following will be octahedral	[MP PET 1999]	()	(a)	Localised on every third	C atom		
	(a) $SF_6$ (b) $BF_4^-$	•		(b)	Present in antibonding or	rbital		
	(c) $PCl_5$ (d) $BO_3^{3-}$		J.	(c) (d)	Localised on each $C$ ato	om		
73	The hybrid orbitals used by central atoms in	ReCl. BCl. and	84.	(u) The	ammonium ion is	structure	2	[CET Pune 1998]
73.	CCL molecules are respectively [MP PMT 1999			(a)	Tetrahedral	(b)	Trigonal py	ramidal
		2		(c)	Square planar	(d)	Square pyra	amidal
	(a) $sp^2$ , $sp^3$ and $sp$ (b) $sp$ , $sp$	and sp	85.	ln s	p hybridisation, shape is			[Bihar MEE 1997]
	(c) $sp^3$ , $sp$ and $sp^2$ (d) $sp^2$ , $sp$	and $sp^3$		(a)	Angular	(b)	Tetrahedral	
74.	The structure of $H_2O_2$ is [CBSE]	MT 1999; AFMC 2003]		(c)	Bipyramidal	(d)	Linear	
	(a) Planar (b) Non-plan	lar		(e)	None of these			
	(c) Spherical (d) Linear		86.	Whe	n the hybridisation state	of carbo	on atom cha	nges from $sp^3$ to
75.	Which of the following is isoelectronic as well a as that of $N_2O$	s has same structure [CPMT 1999]		$sp^2$	to <i>sp</i> , the angle between	n the hyl	oridised orbi	tals
	(a) $N_3H$ (b) $H_2O$			(a)	Decreases gradually	(b)	Increases gi	radually
	(c) $NO_2$ (d) $CO_2$			(c)	Decreases considerably	(d)	All of these	,
76.	$CCl_4$ has the hybridisation	[DPMT 1996]	87.	The	structure and hybridisatio	n of <i>Si</i>	$(CH_3)_4$ is	
	(a) $sp^3d$ (b) $dsp^2$							[CBSE PMT 1996]
	(c) $sp$ (d) $sp^3$			(a)	Bent, <i>sp</i>	(b)	Trigonal, s	$p^2$
77.	Compound having planar symmetry is [ <b>DPMT</b> K	96]		(c)	Octahedral, $sp^3d$	(d)	Tetrahedral	, $sp^3$
,,,	(a) $H_2SO_1$ (b) $H_2O$	,50]	88.	The	type of hybridisation of b	oron in d	liborane is	
	$(c) HNQ_{2} \qquad (d) CCL$							[BHU 1999]
78.	Which of the following compounds is not linear			(a)	<i>sp</i> - hybridisation	(b)	$sp^2$ - hybr	idisation
/0.	Not the following compounds is not finear	[CPMT 1996]		(c)	$sp^3$ - hybridisation	(d)	$sp^3d^2$ - H	ybridisation
	~		89.	Whic	ch compound does not po	ssess lin	ear geometry	1

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					[RPET 1999]	101.	The bond angle is minimum	in		
	(a)	$CH_2 = CH_2$	(b)	$HC \equiv CH$				[Pb. PMT 20	001; MP PET 2003; U	PSEAT 2004]
	(c)	BeCl <sub>2</sub>	(d)	$CO_2$			(a) $H_2 T e$	(b)	H <sub>2</sub> Se	
90.	Whi	ch of the following molecule	does	not show tetrahed	ral shape [ <b>RPET</b>	1999]	(c) $H_2O$	(d)	$H_2S$	
	(a)	CCl <sub>4</sub>	(b)	SiCl <sub>4</sub>		102.	The correct order of hyb	ridization	of the central a	tom in the
	(c)	\$ SF	(4)	CF T			following species $NH_3$ [P	$tCl_4]^{2-}, P$	$Cl_5$ and $BCl_3$ is	
01	(C) Duma	SF <sub>4</sub>	(u)	$CP_4$	[BBET 1000]				[IIT Screening 200	n; BHU 2005]
91.	ryra				[KPET 1999]		(a) $dsp^2$ , $dsp^3$ , $sp^2$ and	$sp^{3}$ (b)	sp <sup>3</sup> , dsp <sup>2</sup> , dsp	$^{3}, sp^{2}$
	(a)	NO <sub>3</sub>	(b)	$H_2O$			(c) $dsp^2$ , $sp^2$ , $sp^3$ , $dsp$	<sup>3</sup> (d)	$dsp^2$ , $sp^3$ , $sp^2$	, $dsp^3$
	(c)	$H_3O^+$	(d)	$NH_4^+$		103.	Which of the following pairs	s has same	structure	[BHU 2001]
92.	Wha	at is the correct mode of hyb	oridiza	tion of the central	atom in the		(a) $PH_3$ and $BCl_3$	(b)	$SO_2$ and $NH_3$	
	follo	wing compounds : $NO_2^+, S_2^+$	$F_{4}$ , PI	$F_{6}^{-}$			(c) $PCl_5$ and $SF_6$	(d)	$NH_4^+$ and $SO_4^2$	-
					[AMU 1999]	104.	The smallest bond angle is f	ound in	[AIIMS 2001]	
	(a)	$sp^2$ , $sp^3$ , $d^2sp^3$	(b)	$sp^3$ , $sp^3d^2$ , $sp$	$p^3 d^2$		(a) <i>IF</i> <sub>7</sub>	(b)	$CH_4$	
	(a)	$sn sn^3 d sn^3 d^2$	( <b>d</b> )	$sn sn^2 sn^3$			(c) $BeF_2$	(d)	BF <sub>3</sub>	
	(C)	sp, sp u, sp u	(u)	sp, sp, sp		105.	Which of the following is no	ot linear	[DCE 2001]	
93.	The	hybridization in $PF_3$ is			[DCE 2000]		(a) <i>CO</i> <sub>2</sub>	(b)	$ClO_2$	
	(a)	$sp^3$	(b)	$sp^2$			(c) $I_{3}^{-}$	(d)	None of these	
	(c)	$dsp^3$	(d)	$d^2 s p^3$		106.	Which of the following is no	ot tetrahedi	ral [ <b>A</b>	NP PMT 2001]
94.	Whi	ch of the following molecule	is line	ear [N	IP PMT 2000]		(a) $SCl_{A}$	(b)	$SO_{4}^{2-}$	
	(a)	$SO_2$	(b)	$NO_2^+$			(c) $Ni(CO)$	(d)	$NiCl^{2-}$	
	(a)	NO <sup>-</sup>	(d)	SCI		107	As the scharacter of hybrid	isation orb	ital increases the l	ond angle [ <b>BHU 2002</b>
	(C)		(u)	3 . 2		6	(a) Increases	(b)	Decreases	
95.	The	geometry of the molecule w	rith s	$p^{3}d^{2}$ hybridised	central atom		(c) Becomes zero	(d)	Does not change	
	15 (a)	INCERT 1981; AFMC 1982; KPA	(h)	Trigonal bipyrami	leb	108.	The shape of $IF_7$ molecule i	is		
	(u) (c)	Octahedral	(d)	Square pyramida			(a) Octabedral	(b)	[AFMC 2002; A	MHCET 2003]
96.	The	bond angle in $PH_3$ is			[RPMT 2000]		(c) Trigonal bipyramidal	(d)	Tetrahedral	innuar
	(a)	Much less than $NH_2$		•	, U	109.	A completely filled <i>d</i> orbital	$(d^{10})$	[U	IPSEAT 2002]
	(b)	Equal to that of NH					(a) Spherically symmetrica	1		
	(0)			0			(b) Has octahedral symmet	try		
	(c)	Much greater than $NH_3$					(c) Has tetrahedral symme (d) Depends on the atom	try		
	(d)	Slightly greater than $NH_3$				110	Which has $sn^3$ hybridizat	ion of cent	ral atom	
<del>9</del> 7.	Wh	ich of the following has tetra	hedra	al structure		110.	which has sp hybridizat		[U	IPSEAT 2002]
				X	[CPMT 2000]		(a) $PCl_3$	(b)	SO <sub>3</sub>	
	(a)	$CO_3^-$	(b)	$NH_4^+$			$(\mathbf{c}) = BF_{\mathbf{c}}$	(d)	$NO_{-}^{-}$	
	(c)	$K_4[Fe(CN)_6]$	(d)	None of these		111.	In which of the following s	species is t	the interatomic bo	ond angle is
98.	The	single, double and triple	bond	lengths of carbo	n in carbon		109°28′	•		[AIEEE 2002]
	diox	ide are respectively			[AIIMS 2000]		(a) $NH_2$ , $(BF_4)^{-1}$	(b)	$(NH_4)^+$ , $BF_2$	
	(a)	1.15, 1.22 and 1.10 Å	(b)	1.22, 1.15 and 1.10	Å		$() \qquad \qquad$	(-)	$(MU)^{-1}$ DE	
	(c)	1.10, 1.15 and 1.22 Å	(d)	1.15, 1.10 and 1.22	Å		(c) $NH_3$ , $BF_4$	(d)	$(NH_2)$ , $BF_3$	1.1
99.	Shap	pe of $BF_3$ molecule is	[CP/	MT 2000; Pb. CET 20	002]	112.	A square planar complex is orbitals	formed by	hybridisation of w	[AIEEE 2002]
	(a)	Linear	(b)	Planar			(a) $s, p_x, p_y, d_{y_z}$	(b)	$s, p_x, p_y, d_{12}$	2
	(c)	Tetrahedral	(d)	Square pyramida	1		(c) $s p = p d$	(L)	sp p d	у
100.	ln	the complex $[SbF_5]^{2-}$ ,	$sp^3a$	l hybridization	is present.		(c) $s, p_x, p_y, a_{z^2}$	(a)	$s, p_y, p_z, a_{xy}$	
	Geo	metry of the complex is		[P	Ъ. РМТ 2000]	113.	In benzene, all the six $C$ – of	C bonds	have the same len	gth because
	(a)	Square Square hinyramidal	(b)	Square pyramida Tetrahodral	I		(a) Tautamarian	(L)	(m <sup>2</sup> huhui li	
	(C)		( <b>a</b> )	retraneural			(a) l'automerism	(b)	<i>sp</i> hybridisation	I

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UNIV	ERSAL SCORER 114 Chem	ical Bonding							
	(c) lsomerism	(d)	Inductive effect		(c)	SO <sub>3</sub>	(d)	$NO_3^-$	
114.	The bond energie	es of $H - H$ and $C$	$Cl-Cl$ are 430 kJ mol $^{-1}$ and	125.	Whie	ch of the following has a l	linear str	ucture [N	AP PMT 2004]
	242 k/ mol $^{-1}$ r	respectively, $\Delta H_t$ fo	r <i>HCl</i> is 91 <i>kJ mol</i> . The bond		(a)	$CCl_4$	(b)	$C_2H_2$	
	energy of <i>HCl</i> wi	ll be	[MP PET 2003]		(c)	SO <sub>2</sub>	(d)	$C_2H_4$	
	(a) $427 k$ (c) $285 k$	(b) (d)	245 k	126.	ln a	regular octahedral molec	cule, MX	$X_6$ , the number	X - M - X
115.	Which of the follo	owing has $dsp^2$ hybr	idization		bond	ls at 180° is		[CB	SE PMT 2004]
		g i ur	[MP PET 2003]		(a) (c)	Six Three	(b) (d)	Four Two	
	(a) $NiCl_4^{2-}$	(b)	SCl <sub>4</sub>	127.	$sp^3$	$d^2$ hybrid orbitals are	(u)	П	MP PET 2004]
	(c) $NH_4^+$	(d)	$PtCl_4^{2-}$		(a)	Linear bipyramidal	(b)	Pentagonal	
116.	Which one of th	e following is a plana	r molecule		(c)	Trigonal bipyramidal	(d)	Octahedral	
			[EAMCET 2003]	128.	ln ar	n octahedral structure, th	e pair of	d orbitals involve	ed in $d^2sp^3$
	(a) $NH_3$	(b)	$H_3O^+$		hybr	idization is		[CB	SE PMT 2004]
	(c) $BCl_3$	(d)	PCl <sub>3</sub>		(a)	$a_{x^2}, a_{xz}$	(D)	$a_{xy}, a_{yz}$	
117.	Which one of the	e following is a correc	t set with respect to molecule,		(c)	$d_{x^2-y^2}, d_{z^2}$	(d)	$d_{xz}, d_{x^2 - y^2}$	
	hybridisation and	shape [EA/	MCET 2003]	129.	The	correct order of	bond a	ngles (smallest	first) in
	(a) $BeCl_2$ , $sp$	$p^2$ , linear			$H_{2}$	$S, IVH_3, BF_3 \text{ and } SIH_4$ is	s DE		[AIEEE 2004]
	(b) $BeCl_2$ , $sp$	$p^2$ , triangular planar			(a)	$H_2S < NH_3 < SiH_4 <$	CBF3		
	(c) $BCl_3$ , $sp^2$	<sup>2</sup> , triangular planar			(b)	$NH_3 < H_2S < SiH_4 < H_2S < H_$	CBF3		
	(d) $BCl_{2}$ $sp^{2}$	<sup>3</sup> tetrahedral			(c)	$H_2S < SiH_4 < NH_3 <$	CBF3		
118.	Which of the fol	lowing compounds de	pesn't have linear structure [ <b>RPE</b>	T 1997200	(d) 131	$H_2S < NH_3 < BF_3 < S$	$SiH_4$	1 1 1 1	
	(a) $CO_2$	(b)	SO <sub>2</sub>		White	ch one of the following ha	as the reg	ular tetrahedral s	tructure
	(c) $BeCl_{2}$	(b)	$C_{2}H_{2}$	.U	(a)	$BF_4$	(b)	$SF_4$	
119.	Which of the fol	llowing bonds requir	e the largest amount of bond		(c)	$XeF_4$	(d)	$\left[Ni(CN)_4\right]^{2-}$	
	energy to dissocia	ate the atom concern	ed		(Ato	mic no. : $B = 5, S = 16$ ,	Ni = 28,	Xe = 54 )	
	( ) <b></b>	1	[UPSEAT 2003]	131.	The	states of hybridazation of	f boron a	nd oxygen atoms	in boric acid
	(a) $H-H$ bot	nd in $H_2$ (b)	$C - C$ bond in $CH_4$		( <i>H</i> <sub>3</sub>	$BO_3$ ) are respectively	[AIEI	E 2004]	
	(c) $N \equiv N$ bo	nd in $N_2$ (d)	$O = O$ bond in $O_2$		(a)	$sp^3$ and $sp^2$	(b)	$sp^2$ and $sp^3$	
	(e) $C - C$ bor	nd in ethane			(c)	$sp^2$ and $sp^2$	(d)	$sp^3$ and $sp^3$	
120.	ethene and ethyn	<i>s</i> -character of the e are respectively	(KCET 2003)	132.	The	hybridisation in $BF_3$ mo	olecule is	[F	<b>Ъ. РМТ 2004]</b>
	(a) 25, 33, 50	(b)	25, 50, 75		(a)	sp	(b)	$sp^2$	
	(c) 50, 75, 100	(d)	10, 20, 40		(c)	$sn^3$	(d)	$sn^3d$	
121.	Arrange the hydr	a-acids of halogens in	increasing order of acidity	100	Amo	<sup>27</sup> [Orissa JEE 2003]	BE M		A BeCl
	(a) $HF < HCl$	l < HBr < HI (b)	HI < HBr < HCl < HF	133.	ident	tify the ones in which tl	he centra	l atom has the s	same type of
	(c) $HF < HBi$	r < HI < HCl (d)	HF < HI < HBr < HCl		hybr	idisation		[Kera	ala PMT 2004]
122.	Which one has s	$p^2$ – hybridisation	[MP PMT 2004]		(a)	$BF_3$ and $NCl_3$	(b)	$H_2S$ and $BeCl$	2
	(a) $CO_2$	(b)	$N_2O$		(c)	$BF_3$ , $NCl_3$ and $H_2S$	(d)	$SF_4$ and $BeCl_2$	2
	(c) $SO_2$		<i>CO</i>		(e)	NCLs and Has			
123.	Among the follo	wing compounds the $2^2$ l l i i i	e one that is polar and has		(e)				
	central atom with	n <i>sp</i> – hybridization	[MP PMT 2004: 11T 1997]	134.	The	molecule of $CO_2$ has 1	80° bond	angle. It can be	explanid on
	(a) $H_2CO_3$	<b>(</b> b)	<i>BF</i> <sub>3</sub>		the t	3		2	[תראו⊂ 2004]
	(c) $SiF_4$	(d)	HClO <sub>2</sub>		(a)	<i>sp</i> <sup>°</sup> hybridisation	(b)	<i>sp</i> <sup>2</sup> hybridisatio	n
124.	The molecule wh	ich is pyramid shape	is		(c)	sp hybridisation	(d)	$d^2sp^3$ hybridisa	ation
	N	[MP P/	MT 2004; EAMCET 1985; IIT 1989]	135.	sp	<sup>3</sup> hybridisation is found i	'n		
	(a) $PCl_3$	(b)	$CO_{3}^{2-}$		-			[Pb. CET 2003; Or	rissa JEE 2005]

(a) $CO_1^{-1}$ (b) $BF_1$ (c) $d^2y^2$ $d^2y^2$ $d^2y^2$ (b) $NO_2^{-1}$ (c) $d^2y^2$ $d^2y^2$ $d^2y^2$ $d^2y^2$ (c) $d^2y^2$ $d^2y^2$ $d^2y^2$ $d^2y^2$ $d^2y^2$ (c) $yp^2$ $yp^2$ $xp^2d^2$ $yp^2d^2$ $d^2y^2$ (c) $yp^2d^2$ $d^2y^2^2$ $d^2y^2^2$ $d^2y^2$ (d) $xp^2d^2$ $yp^2d^2$ $d^2y^2^2$ $d^2y^2$ (e) $yp^2d^2$ $d^2y^2^2$ $d^2y^2^2$ $d^2y^2^2$ (f) $yp^2d^2$ $d^2y^2^2$ $d^2y^2^2$ $d^2y^2^2$ (g) $xp^2d^2$ $d^2y^2^2$ $d^2y^2^2$ (g) $d^2y^2^2$ $d^2y^2^2$ $d^2y^2^2$ (g) $d^2y^2^2^2$ <td< th=""><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th>Chemie</th><th>cal B</th><th>onding 115</th><th>UNIVERSAL SELF SCORER</th></td<>									Chemie	cal B	onding 115	UNIVERSAL SELF SCORER
(i) $N_{0,1}$ (i) $N_{1,1}$ (ii) $N_{1,1}$ $N_{2,1}$ <th></th> <th>(a)</th> <th><math>CO_{3}^{2-}</math></th> <th>(b)</th> <th>BF<sub>3</sub></th> <th></th> <th></th> <th>(c) <i>a</i></th> <th><math>d^2sp^3</math> or <math>sp^3d^2</math></th> <th>(d)</th> <th><math>d^3sp^2</math> or <math>d^2</math></th> <th><math>2^{2}sp^{3}</math></th>		(a)	$CO_{3}^{2-}$	(b)	BF <sub>3</sub>			(c) <i>a</i>	$d^2sp^3$ or $sp^3d^2$	(d)	$d^3sp^2$ or $d^2$	$2^{2}sp^{3}$
(i)(i)(ii)(iii)(iii)(iii)(iiii)(iiii)(iii)(i		(c)	NO <sup>-</sup>	(d)	NH.		146.	The v	alency of carbon is four. (	On wha	t principle it ca	an be explained
NoST $PT_{1}$ (MOT Biller 1983)NO $ST_{4}$ $PT_{2}$ (PT)(a) $sp$ , $sp^{2}$ , $sp^{3}$ (PT)(b) $sp$ , $sp^{2}$ , $sp^{3}$ (PT)(c) $sp^{2}$ , $sp^{3}$ , $sp^{3}q^{2}$ (PT)(d) $sp^{3}$ , $sp^{3}q^{2}$ (PT)(PT)(e) $sp^{2}$ , $sp^{3}q^{2}$ (PT)(PT)(f) $sp^{3}q^{2}$ , $sp^{3}q^{2}$ (PT)(PT)(f) $sp^{3}q^{2}$ , $sp^{3}q^{2}$ (PT)(PT)(f) $sp^{3}q^{2}$ (PT)(PT)(PT)(PT)(f) $sp^{3}q^{2}$ (PT)(PT)(PT)(PT)(f) $sp^{3}q^{2}$ (PT)(PT)(PT)(PT)(g) $sp^{3}q^{2}$ (PT)(PT)(PT)(PT)(g) $sp^{2}q^{2}$ (PT)(PT)(PT)(PT)(g) $sp^{3}q^{2}$ (PT)(PT)(PT)(PT)(g) $sp^{3}q^{2}$ (PT)(PT)(PT)(PT)(g) $sp^{3}q^{2}$ (PT)(PT)(PT)(PT)(g) $sp^{2}q^{2}$ (PT)(PT)(PT)(PT)(g) $sp^{2}q^{2}$ (PT)(PT)(PT)(PT)(g) $sp^{2}q^{2}$ (PT)(PT)(PT)(PT)(g) $sp^{2}q^{2}$ (PT)(PT)(PT)(PT)(g) $sp^{2}q^{2}$ (PT)(PT)(PT)(PT)(g) $sp^{2}q^{2}$ (PT	126	(C) Whi	ch set bydridication is	(u)	he following	compounds[Ph CET	[ 2002]	in a b	etter way Sesonance	(b)	Hybridization	
$M^{0}_{2}$ : $Sr_{1}$ $P_{n}$ $P_{n}$ $P_{n}$ (a) $pp$ , $sp^{2}$ , $sp^{2}$ , $sp^{2}d^{2}$ (a) $correlation is different energy events(b) correlation is different energy events(c) corre$	130.	vviin			ne tonowing		2003]	(c) E	Electron transfer	(d)	None of the al	oove
(a) $sp^{2}$ , $sp^{3}$ , $sp^{4}d^{2}$ (b) $sp^{2}$ , $sp^{3}d^{2}$ , $sp^{3}d^{2}$ (c) $sp^{3}$ , $sp^{3}d^{2}$ , $sp^{3}d^{2}$ (d) $sp^{3}$ , $sp^{3}d^{2}$ , $sp^{3}d^{2}$ (e) $sp^{3}$ , $sp^{3}d^{2}$ , $sp^{3}d^{2}$ (f) $sp^{3}$ , $sp^{3}d^{2}$ , $sp^{3}d^{2}$ (g) $sp^{3}$ , $sp^{3}d^{2}$ , $sp^{3}d^{2}$ (g) $sp^{3}$ , $sp^{3}d^{2}$ , $sp^{3}d^{2}$ (g) $sp^{3}d^{2}$ , $(d)$ , $sp^{2}d^{2}$ (g) $pCl_{+}$ , $(b)$ , $SO_{+}$ (g) $pCl_{+}$ , $(b)$ , $SP^{2}d^{2}$ (g) $pCl_{+}$ , $(b)$ , $SP^{2}d^{2}$ (g) $dD_{+}^{2}$ , $(b)$ , $dO_{+}^{2}$ (g) $dD_{+}^{2}$ , $(b)$ , $dD_{+}^{2}$ (g) $dD_{+}^{2}$ , $(b)$			$NO_2$ , $SF_4$	$PF_6$			147.	Hybrid	dization is due to the over	lapping	g of	
(b) $sp$ , $sp^2d$ , $sp^2d^2$ (c) $sp^2$ , $sp^2d^2$ , $sp^2d^2$ (d) $sp^2$ , $sp^2d^2$ , $sp^2d^2$ (e) $Orbitals of affirment energy content (f) None of the above (f) sp^2, sp^2d^2, sp^2d^2(g) sp^2d^2(h) dp^2(h) dp^2(h) dp^2(h) dp^2d^2(h) dp^2(h) dp^2d^2(h) dp^2(h) dp^2d^2(h) dp^2d^2(h) dp^2(h) dp^2d^2(h) $		(a)	$sp$ , $sp^2$ ,	$sp^3$				(a) (	Drbitals of different energy	y levels		ADT Bihar 1983
(c) $sp^2$ , $sp^3$ , $d^3sp^3$ (d) $sp^3$ , $sp^4d^2$ , $sp^4d^2$ , $sp^4d^2$ (e) $rest and flybridization of B in BCI3 is (b) sp^2 (c) sp^3 (d) sp^2d^2(e) sp^3 (d) sp^2d^2(f) Str Taboos BHU 2004](f) sp^2 (d) sp^2d^2(g) sp^3d^2 (h) sp^2(g) sp^3d^2 (h) sp^2d^2(g) sp^2d^2 (h) sp^2d^2(g) sp^2d^2 (h) sp^2d^2(g) sp^2d^2 (h) sp^2^2(g) sp^2d^2 (h) sp^2(g) sp^2d^2 (h) sp^2(g) sp^2d^2 (h) sp^2(g) rest are subpart in SO2 molecule is [DCE 2004] (g) sp^2d^2 (h) sp^2(g) rest are subpart in SO2 molecule is [DCE 2004] (g) sp^2d^2 (h) sp^2(g) rest are subpart in SO2 molecule is [DCE 2004] (g) rest are subpart in SO2 (h) sp^2(g) rest are subpart in SD2 (h) sp^2(g) res are subpart in SD2 (h) sp^2(g) rest are subpart in SD2$		(b)	$sp$ , $sp^3d$ ,	$sp^3d^2$				(b) C	Drbitals of different energy	y conte	nt	
(d) $sp^{1}$ , $sp^{2}d^{2}$ , $sp^{3}d^{2}$ The state of hybridisation of $B$ in $BCI_{3}$ is <b>[Ph. CET 2006; BHU 2004]</b> (a) $sp$ (b) $sp^{2}$ (c) $sp^{3}d$ (d) $sp^{2}d^{2}$ (e) $sp^{3}d^{2}$ (d) $sp^{2}d^{2}$ (f) $sp^{3}d^{2}$ (h) $sp^{2}$ (g) $sp^{2}d^{2}$ (h) $sp^{2}d^{2}$ (g) $d^{2}sp^{2}$ (h) $d^{2}sp^{2}$ (g) $d^{2}sp^{2}$ (h) $d^{2}sp$		(c)	$sp^2$ , $sp^3$ ,	$d^2sp^3$				(c) (d) N	Drbitals of same energy co None of the above	ontent		
The state of hybridization of B in BCl <sub>3</sub> isorbital used by M are(IPT 1959; MP PMT 1994; Kerels FMT 2004(a) $sp$ (b) $sp^2$ (c) $sp^2 d$ (d) $sp^2 d^2$ (d) $sp^2 d - hybrid(e) sp^2 d - hybrid(f) $		(d)	$sp^3$ , $sp^3d^2$ .	$sn^3d^2$			148.	lf a n	nolecule $MX_3$ has zero	dipole	moment, the	sigma bonding
13.7Pick CRT 2000; BHU 2004] (b) $sp^2$ (b) $sp^2$ (c) $sp^3 d - hybrid(c) sp^2 d - hybrid(c) sp^2 d - hybrid(c) sp^2 - hybrid(c) sp^2 d - hybrid(c) hydrid + hy$	127	(u) The	state of hybridication	of R in R	Cl is			orbita	l used by <i>M</i> are	5		
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	137.	The	state of hybridisation		[Ph CF	T 2000- BHU 2004]			3	IT 1981;	MP PMT 1994; K	erala PMT 2004]
(a) $3p^2$ (b) $3p^2$ (c) $sp^2$ (d) $sp^2$ (e) $sp^2$ (f) $sp^2$ (f) $sp^2$ (a) $sp^2$ (b) $sp^2$ (c) $sp^2$ (d) $NO_2^+$ (e) $SP_2^-$ (d) $NO_2^+$ (a) $sp^2$ (d) $sp^2$ (d) $Sp^2$ (d) $NO_2^+$ (e) $SP_2^-$ (d) $NO_2^+$ (a) $sp^2$ (d) $sp^2$ (d) $Sp^2$ (d) $NO_2^+$ (e) $SP_2^-$ (d) $NO_2^+$ (e) $CO_2^-$ (d) $NO_2^-$ (e) $CO_2^-$ (d) $NO_2^-$ (e) $CP_2^-$ (d) $NP_2^-$ (e) $CO_2^+^-$ (d) $NO_2^-$ (e) $CP_2^-$ (e) $APCI_3$ (b) $SP^2$ (f) $SP^-$ (e) $CO_3^-^-$ (d) $NO_2^-$ (f) $CET$ 2001(a) $sp^2$ (d) $dp^2$ (f) $dp^2$ (e) $CH_4$ (d) $PH_3^-$ (f) $SP^-$ (f) $dp^-$ (f) $dp^-$ (f) $dp^-$ (e) $CH_4$ (d) $PH_3^-$ (f) $dp^-$ (f) $dp^-$ (f) $dp^-$ (f) $dp^-$ (f) $sp^2$ - hybridization $distorted is transfer is minitary is minitar generative i$		(-)		<b>(L)</b>	(FD. CL	1 2000; brid 2004j		(a) .	$sp^3d$ – hybrid	(b)	sp – hybrid	
(c) $gp^2$ (d) $gp^2/d^2$ (p) $gp^2/d^2$ (d) $gp^2$ (a) $sp^2 d^2$ (d) $sp^2$ (d) $sp^2$ (d) $NO_2^-$ (a) $sp^2 d^2$ (d) $sp^2$ (d) $sp^2$ (d) $NO_2^-$ (a) $PCI_3$ (b) $SO_3$ (d) $sp^2$ (d) $dsp^2$ (a) $PCI_3$ (b) $SO_3$ (d) $sp^2$ (d) $dsp^2$ (a) $PCI_3$ (b) $SO_3$ (d) $sp^2$ (d) $dsp^2$ (e) $CO_3^-$ (d) $NO_3^-$ (ECE 2005)(d) $PCI_3$ , $MI_3$ (b) $sp^2 d$ (c) $CO_3^-$ (d) $NO_3^-$ (g) $PCI_3$ , $MI_3$ (b) $sp^2 d$ (g)(a) $sp^3 d^3$ (b) $sp^2 d$ (g) $dsp^- c$ (g) $dsp^- c$ (c) $d^2 sp^3$ (d) $sp^3$ (g) $ds^- c^- c^- c^+$ (g)(a) $sp^- d^+$ (b) $HI$ (g) $ds^- c^- c^- c^+$ (g)(a) $sp^- d^- c^- c^- c^+$ (g) $ds^- c^- c^- c^+ c^- c^- c^+$ (g) $ds^- c^- c^- c^+ c^- c^- c^+$ (b) $sp^- d^- c^- c^- c^+ c^+ c^- c^- c^- c^+ c^- c^- c^- c^+ c^+ c^- c^- c^- c^+ c^- c^- c^- c^+ c^- c^- c^- c^+ c^+ c^- c^- c^- c^- c^- c^- c^+ c^- c^- c^- c^- c^+ c^- c^- c^- c^- c^- c^- c^- c^- c^- c^-$		(a)	sp	(b)	sp			(c) . TI I	$sp^3d^2$ – hybrid	(d)	$sp^2$ – hybrid	[1107] en est
138.The hybrid state of sulphur in $SO_3$ molecule is (c) $sp^3d$ (b) $sp^3$ IDCE 2004]IACC(a) $sp^3d$ (b) $sp^3$ (c) $SD_3$ (c) $CS_2$ (d) $NO_2^*$ (b) $PCI_3$ (c) $CO_2^{}$ (d) $NO_3^-$ (c) $CS_2$ (d) $dsp^2$ (c) $CO_2^{}$ (d) $NO_3^-$ (c) $CC_1$ (d) $RCC_2$ (a) $sp^3d^3$ (b) $sp^3d$ (c) $Sp^2d$ (c) $d^2sp^3$ (d) $sp^3$ (c) $Sp^2d$ (c) $d^2sp^3$ (d) $sp^3$ (c) $d^2sp^3$ (d) $MF$ (b) $MI$ (c) $d_2^-$ (d) $d_3^-$ (e) $CC_4 + (CI_4)$ (d) $PH_3$ (f) $RF$ (b) $MI$ (c) $d_2^-$ (d) $d_3^-$ (g) $sp^3$ hybridization and distorted tetrahedral geometry(g) $sp^3$ hybridization and distorted tetrahedral geometry(g) $sp^3$ hybridization and distorted tetrahedral geometry(g) $sp^3$ hybridization(h) None of these(h) Nore of these(h) Strategraphication(h) Nore of these(h) Trigonal hybridization(h) Nore of these(h) Trigonal hybridization(h) Nore of these(h) Trigonal hybridization(h) Nor		(c)	sp <sup>3</sup>	(d)	$sp^2d^2$		149.		Sucl	by (b)	NCO <sup>-</sup>	[111-1991]
(a) $sp^3d$ (b) $sp^3$ (c) $CS_2$ (d) $NO_2^-$ (g) $sp^3d^2$ (d) $sp^2$ (g) $sp^2$ (f) $Sp^2$ (f) $Sp^2$ (f) $Sp^2$ (f) $Sp^2$ (g) $PCI_3$ (b) $SO_3$ (f) $Sp^2^-$ (g) $Sp^2^-$ (g) $Sp^2^-$ (g) $Sp^2^-$ (g) $Sp^2^-$ (g) $sp^3d^3$ (b) $sp^2d$ (g) $Sp^3d^3$ (g) $sp^3d^3$ (g) $sp^2d$ (g) $Sp^2d^-$ (g) $dsp^2d^-$ (a) $HF$ (b) $HI$ (c) $CI_4$ (d) $PH_3$ (f) $CET 2004$ (g) $CET 2004$ (g) $CET 2004$ (a) $HF$ (b) $HI$ (c) $CI_4$ (d) $PH_3$ (f) $CET 2004$ (g) $CET 2004$ (g) $CET 2004$ (a) $HF$ (b) $HI$ (c) $CI_4$ (d) $PH_3$ (c) $d_2^-$ (b) $d_{37}$ (c) $CF_4$ (d) $PH_3$ (f) $CET 2004$ (g) $CET 2004$ (g) $CET 2004$ (a) $Sp^3$ dy3 d(b) $Sp^3$ (f) $CET 2004$ (c) $d_2^-$ (b) $d_{37}$ (e) $CH_4$ (b) $HI$ (c) $CH_4$ (d) $PH_3$ (c) $d_2^-$ (b) $d_{37}$ (c) $sp^2$ hybridization and tistored tetrahedral geometry(c) $sp^2$ hybridization and distored tetrahedral geometry(c) $CH_4$ (b) $NH_3$ (f) $Sp^3$ hybridization(f) $CET 2004$ (a) $CH_4$ (b) $NH_3$ (c) $H_2O$ (d) $HF$ (g) $Sp^2$ hybridization(g) $CET 2004$ (g) $CET 2004$ (g) $CH_4$ (h) $NH_3$ (c) $H_2O$ (d) $HF$ (h) $Sp^3$ hybridization(f) $CET 2004$ (g) $CH_4$ (h) $NH_3$ (c) $H_2O$ (d) $HF$ (h) $Sp^2$ hybridization(f) $CCT 2004$ (g) $CH_4$ (h) $NH_$	138.	The	hybrid state of sulph	ur in $SO_3$	molecule is	[DCE 2004]		(a) ,		(0)	NCO	
(c) $sp^2 d^2$ (d) $sp^2$ (b) $sp^2 d^2$ (d) $sp^2$ (b) $sp^2 d^2$ (d) $dsp^2$ (c) $CO_3^2^-$ (d) $NO_3^-$ (d) $sp^3 d^3$ (b) $sp^2 d$ (c) $d^2sp^3$ (d) $sp^3$ (d) $p^2$ (b) $d_3y$ (c) $CH_4$ (d) $PH_3$ (a) $PL^-$ (b) $d_3y$ (c) $CH_4$ (d) $PH_3$ (a) $Sp^3$ -hybridization and triangular geometry(a) $PL^-$ (b) $d_3y$ (c) $Sp^2$ -hybridization(MH CET 2004](a) $Decalization of sigma electrons(b) CO_2(b) PCET 199; Kunkahetra CEE 1998](a) Ap^3 or sp^2 d(b) Apy or sp^2 d(a) CO_2(b) CO_2(a) CO_2(b) CO_2(a) CO_2(b) CO_2(a) CO_2(b) Apy<$		(a)	$sp^{3}d$	(b)	$sp^3$			(c) (		(d)	$NO_2$	
13.9.Which of the following molecules has pyramidal shape [DCE 2004; Jak CET 2005] (a) $PCI_5$ (b) $SO_3$ (c) $CO_3^2^-$ (d) $NO_3^-$ (a) $Sp^2$ (b) $Sp_2$ (b) $SP_2$ 140.The hybridization of $IF_7$ is (c) $d^2sr^3$ (d) $sp^3$ [Ps. CET 2001] (b) $sp^2d$ [Jak CET 2005] (c) $d^2sr^3$ (d) $sp^3$ [Jak CET 2005] (c) $d^2sr^2$ (b) $d_{xy}$ 141.In which compound, the hydrogen bonding is the strangets in its (picule d) hase (c) $CH_4$ (d) $PH_3$ The d-orbital involved in $sp^3d$ hybridisation is (c) $d_2s$ (d) $d_{2x}$ 142.Geometry of ammonia molecule and the hybridization of nitrogen involved in it are (b) $sp^3$ -hybridization and triangular geometry (c) $sp^2$ -hybridization and triangular geometry (d) None of these[MH CET 2004] (a) $Diagonal hybridization(c) Terahedral hybridization(d) None of these[MH CET 2004](a) Diagonal hybridization(c) Terahedral hybridization(c) Terahedral hybridization(c) CS_2 (d) BeCI_2[MH CET 2004](a) Diagonal hybridization(c) CS_2 (d) BeCI_2[MH CET 2004](a) CO_2[MH CET 2004](a) CO_2[MH CET 2004](a) CO_2[MH CET 2004](a) CO_2 (b) CO_2[MH CET 2004](a) CS_2 (c) (D = C - O^-(b) NH_3[MU 1983](a) Alomic arrangements(b) Electronic arrangements(c) Functional groups (d) Alyly groups144.Which of the following is non-linear molecule(c) CS_2 (d) BeCI_2[MH CET 2004](a) Alomic arrangements (b) Electronic arrangements(c) Functional groups (d) Alyly groups144.Which$		(c)	$sp^3d^2$	(d)	$sp^2$		150.	Hybrid	disation of central atom in	$NF_3$	15	Orissa JEE 2005]
$ \begin{bmatrix}   DCE 2004;   kK CET 2005 \end{bmatrix} \\ (a) PCl_{5} (b) SO_{3} \\ (b) CO_{3}^{2^{-}} (c) NO_{5}^{-} \\ (c) CO_{4}^{2^{-}} (c) NO_{5}^{-} \\ (c) CO_{4}^{-} \\ (c) CO_{4}^{-} (c) NO_{5}^{-} \\ (c) CO_{4}^{-} \\ (c) CO_{4}^{-$	139.	Wh	ich of the following m	olecules has	pyramidal sh	ape		(a) .	sp <sup>3</sup>	(b)	sp	
(a) $PCl_3$ (b) $SO_3$ (jak CET 2005)(c) $CO_3^2^-$ (d) $NO_3^-$ (e) $PCl_3, NH_3$ (b) $BeCl_2, H_2O$ (a) $sp^3 d^3$ (b) $sp^2 d$ (c) $CH_4, CCl_4$ (d) $H_5, PF_5$ (a) $sp^3 d^3$ (b) $sp^2 d$ (c) $CH_4, CCl_4$ (d) $H_5, PF_5$ (c) $d^2 sp^2$ (d) $sp^3$ (b) $HF$ (b) $HI$ (c) $CH_4$ (d) $PH_3$ (d) $d_{x^2-y^2}$ (b) $d_{xx}$ (a) $BF$ (b) $HI$ (c) $CH_4$ (d) $PH_3$ (d) $d_{x^2-y^2}$ (d) $d_{xx}$ (a) $sp^3$ -hybridization and tetrahedral geometry(a) $O = C = O$ (b) $O - C = O^*$ (c) $d_{x^2-y^2}$ (d) $O = C = O$ (a) $sp^3$ -hybridization and istorted tetrahedral geometry(a) $O = C = O$ (b) $O - C = O^*$ (c) $*O = C = O$ (d) $O = C = O$ (b) $sp^3$ -hybridization and tistorted tetrahedral geometry(e) $*O = C = O^-$ (d) $O = C = O$ (e) $H = C = O^-$ (d)None of these(MH CET 2004]3.Resonance is due to(NCERT 1981; Kurukahera CEE 1998](a)Diagonal hybridization(b) $CO_2$ (c) $H_2O$ (d) $HF$ (a)CO_2(b)CO_2(c) $GEC_2$ (d)Mul 1983](a)Albrid groups(b)Diagonal hybridization(b) $CO_2$ (c) <td></td> <td></td> <td></td> <td></td> <td>[DCE 20</td> <td>004; J&amp;K CET 2005]</td> <td></td> <td>(c) .</td> <td><math>sp^2</math></td> <td>(d)</td> <td><math>dsp^2</math></td> <td></td>					[DCE 20	004; J&K CET 2005]		(c) .	$sp^2$	(d)	$dsp^2$	
(c) $CO_3^{2-}$ (d) $NO_3^{-}$ (e) $CO_3^{-}$ (e) $CO_3^{-}$ (f) $DO_2^{-}$ 140. The hybridization of $IE_7$ is(Pb. CET 2001)(c) $CH_4$ , $CCI_4$ (d) $IE_5$ , $PE_5$ (a) $sp^3d^3$ (b) $sp^2d$ (c) $d^2sp^3$ (d) $sp^3$ (e) $d_{xx}$ (c) $d^2sp^3$ (d) $sp^3$ (e) $HI$ (f) $d_{x^2-y^2}$ (b) $d_{xy}$ (c) $CH_4$ (d) $PH_3$ (e) $CT$ 2001](f) $d_{x^2}$ (f) $d_{x^2}$ 142. Geometry of ammonia molecule and the hybridization of nitrogen involved in it are(MH CET 2004](a) $0 = C = O$ (b) $-O - C = O^*$ (c) $sp^3$ - hybridization and tetrahedral geometry(b) $sp^3$ - hybridization and tistorted tetrahedral geometry(c) $H_2O$ (d) $HE^*$ 143. Be in BeCl_2(MH CET 2004](a) Delocalization of protons(b) NH_3(c) $H_2O$ (d) $HE^*$ 144. Which of the following is non-linear molecule(DCE 2003](a) CO_3(b) $CO_2$ (c) $H_2O$ (d) $HE^*$ 144. Which of the following is non-linear molecule(DCE 2003](a) $Aigration of protons$ (b) $Electronic arrangements$ (c) $Harman equation of protons$ 144. Which of the following is non-linear molecule(DCE 2003](a) $Aigration of protons$ (b) $Electronic arrangements$ (c) $Harman equation of protons$ 145. The trigonal hybridization(b) $dsp^2$ or $sp^2d$ (c) $Auu 1983$ (c) $Auu 1983$ (c) $Auu 1983$ 146. Which of the following is non-linear molecule(DCE 2003](c) $Aigration of protons$ (c) $Harman equation of protons$ 147. The trigonal hybridization(b) $dsp^2$ o		(a)	$PCl_3$	(b)	$SO_3$		151.	(a)	air having similar geometr	-y 1s (b)	BeCla, HaO	[J&K CET 2005]
140.The hybridization of $IF_{7}$ is (a) $sp^{3}d^{3}$ (b) $sp^{2}d$ (c) $d^{2}sp^{3}$ (d) $sp^{3}$ [b, CET 200] (b) $sp^{2}d$ (c) $d^{2}sp^{3}$ (d) $sp^{3}$ 152.The d orbital involved in $sp^{3}d$ hybridisation is [JGK CET 2005]141.In which compound, the hydrogen bongound, the hydrogen bongound in is the strongest in its liquid phase (c) $CH_{4}$ (d) $PH_{3}$ 1.Which one in the following is not the resonance structure of $CO_{2}$ 142.Geometry of ammonia molecule and the hybridization of nitrogen involved in it are (a) $sp^{3}$ -hybridization and tetrahedral geometry (b) $sp^{3}$ -hybridization and distorted tetrahedral geometry (c) $sp^{2}$ -hybridization and distorted tetrahedral geometry (d) None of these(MH CET 2004] (a) $CH_{4}$ (b) $NH_{3}$ (c) $H_{2}O$ (c) $H_{2}O$ (d) $HF$ 143.Be in BeCl_{2} (c) $CS_{2}$ (b) $CO_{2}$ (d) $Nubridization(e) Tetrahedral hybridization(f) or hybridization(g) Nubridization(g) Nubridization(g) Nubridization(g) Nubridization(g) CS_{2}(BH CET 2004](g) CH_{4}(b) NH_{3}(c) H_{2}O(c) H_{2}O(d) HF144.Which of the following is non-linear molecule(a) CO_{3}(b) CO_{2}(c) CS_{2}(b) CO_{2}(d) BeCl_{2}(c) H_{2}O(d) Alkyl groups145.The trigonal bipyramidal geometry results from the hybridisation(a) dsp^{2} or sp^{3}d(b) dsp^{2} or sp^{2}d(c) d_{2}(d) Alkyl groups(c) H_{2}O(d) Alkyl groups145.The trigonal bipyramidal geometry results from the hybridisation(a) dsp^{2} or sp^{3}d(b) dsp^{2} or sp^{2}d(c) H_$		(c)	$CO_{3}^{2-}$	(d)	$NO_3^-$			(c)	CH., CCL	(d)	$IE_{2}, IE_{2}$	
(a) $sp^3 d^3$ (b) $sp^2 d$ (c) $d^2 sp^3$ (d) $sp^3$ (e) $sp^2 d$ (f) $d^2 sp^3$ (f) $sp^3$ (f) $sp^3$ (f) $d^2 sp^3$ (g) $d^2 sp^2 d$ (g) $d^2 sp^2$ (g) $d^2 sp^2 d$ (g) $d^2 sp^2 d^2 g)$ (g) $d^2 sp^2 d$	140.	The	hybrdization of <i>IF</i> 7	is		[Pb. CET 2001]	150	The d	$d_4, c_{44}$	h h i	liantian is	
(c) $d^2sp^3$ (d) $sp^3$ (e) $d^2sp^3$ (d) $sp^3$ (f)In which compound, the hydrogen bonding is the strongest in its liquid phase(f) $d_{x^2}$ (a) $HF$ (b) $HI$ (c) $d_{x^2}$ (a) $HF$ (b) $HI$ (c) $d_{x^2}$ (c) $CH_4$ (d) $PH_3$ (e) $Resonance$ (a) $Sp^3$ -hybridization and tetrahedral geometry(b) $sp^3$ -hybridization and istorted tetrahedral geometry(e) $rO = C = O$ (g) $sp^3$ -hybridization and triangular geometry(f) $rO = C = O$ (g) $O = C = O$ (h) $sp^3$ -hybridization and triangular geometry(g) $rO = C = O$ (h) $O = C = O$ (h) $sp^3$ -hybridization and triangular geometry(g) $rO = C = O$ (h) $PO = C = O^2$ (h) $sp^3$ -hybridization and triangular geometry(g) $CH_4$ (h) $NH_3$ (g)None of these(g) $CH_4$ (h) $NH_3$ (a) $CO_2$ (g)(h) $CO_2$ (g)(h) $Resonance is due to(h)(h)No hybridization(g)(g)Resonating structures have different[AMU 1983](a)CO_2(g)BeCl_2(g)Atomic arrangements(h)(h)Asp^3 or sp^3d(h)dsp^2 or sp^2d(h)Atomic arrangements$		(a)	$sp^3d^3$	(b)	$sp^2d$		152.	The <i>a</i>	-orbital involved in sp u	nybric	IISALIOIT IS	[J&K CET 2005]
(c) $d sp$ (c) $sp$ (c) $sp$ (d) $hdr(e) HI(f) CET 2001(a) HF(b) HI(c) CH_4(d) PH_3(e) CH_4(d) PH_3(e) Geometry of ammonia molecule and the hybridization of nitrogen involved in it are(MH CET 2004](a) sp^3 -hybridization and tetrahedral geometry(b) sp^3 -hybridization and triangular geometry(c) f = C - O^-(d) O = C = O(d) None of these(MH CET 2004](a) CH_4(b) NH_3(d) Nohybridization(c) Tetrahedral hybridization(c) H_2O(d) HF(d) No hybridization(f) CO_2(d) BeCl_2(f) CEE 2003](a) CO_3(b) CO_2(a) CO_3(b) CO_2(c) Functional groups(d) Alkyl groups(a) dsp^3 or sp^3d(b) dsp^2 or sp^2d(c) Functional groups(d) Alkyl groups(a) dsp^3 or sp^3d(b) dsp^2 or sp^2d(AMU 1984]$		( ) (a)	$d^2 s n^3$	(J)	sn <sup>3</sup>			(a) a	$d_{x^2-y^2}$	(b)	$d_{xy}$	
Interview <td>141.</td> <td>ln v</td> <td><i>u sp</i> which compound the</td> <td>u) hvdrogen b</td> <td><i>sp</i> onding is th</td> <td>e strongest in its</td> <td></td> <td>(c) a</td> <td><math>d_{z^2}</math></td> <td>(d)</td> <td><math>d_{zx}</math></td> <td></td>	141.	ln v	<i>u sp</i> which compound the	u) hvdrogen b	<i>sp</i> onding is th	e strongest in its		(c) a	$d_{z^2}$	(d)	$d_{zx}$	
(a) $HF$ (b) $HI$ (c) $CH_4$ (d) $PH_3$ I.Which one in the following is not the resonance structure of $CO_2$ 142.Geometry of ammonia molecule and the hybridization of nitrogen involved in it are $[MH CET 2004]$ (a) $O = C = O$ (b) $\neg O - C = O^+$ (a) $sp^3$ -hybridization and tetrahedral geometry(b) $sp^3$ -hybridization and distorted tetrahedral geometry(c) $*O = C - O^-$ (d) $O = C = O$ (b) $sp^3$ -hybridization and triangular geometry(d)None of these(a) $CH_4$ (b) $NH_3$ (d)None of these[MH CET 2004]3.Resonance is due to[NCERT 198]; Kurukahetra CEE 1998](a)Diagonal hybridization(c) $H_2O$ (d) $HF$ (d)No hybridization(d) $BeCl_2$ (b) $CO_2$ (d)(a) $CO_2$ (b) $CO_2$ (c) $Hictore scale(c)(a)CO_3(b)CO_2(c)Hictore scale(c)(a)CO_3(b)CO_2(c)Hictore scale(c)(a)CO_3(b)CO_2(c)Hictore scale(d)(a)CO_3(b)CO_2(c)Functional groups(d)(a)Algradion of protons(c)Functional groups(d)Alkyl groups(b)CO_3(b)dsp^2 or sp^2d(a)CH4(b)(c)Functional groups(d)Alkyl groups(d)<$		liqui	d phase	nyarogen e		[Pb. CET 2001]			Reson	ance	2	
(c) $CH_4$ (d) $PH_3$ 1.Which one in the following is not the resonance structure of $CO_2$ 142.Geometry of ammonia molecule and the hybridization of nitrogen involved in it are(MH CET 2004](a) $O = C = O$ (b) $\neg O - C = O^+$ (a) $sp^3$ -hybridization and tetrahedral geometry(b) $sp^3$ -hybridization and distorted tetrahedral geometry(c) $*O = C - O^-$ (d) $O = C = O$ (d)None of these(d)None of these(e) $HCET 2004$ ](f) $HF$ 143.Be in $BeCl_2$ undergoes[MH CET 2004]3.Resonance is due to[NCERT 198]; Kurukshetra CEE 1998](a)Diagonal hybridization(c) $H_2O$ (d) $HF$ 144.Which of the following is non-linear molecule[DCE 2003](a)Negration of protons(b) $CO_3$ (b) $CO_2$ (c) $Hacms(d)(a)CO_3(b)CO_2(d)BeCl_2(a)(c)CS_2(d)BeCl_2(d)Atomic arrangements(b)(a)CO_3(b)CO_2(c)Functional arrangements(b)(a)CO_3(b)GO_2(c)Functional arrangements(c)(a)Aconic arrangements(b)Electronic arrangements(c)Functional arrangements(c)(a)Aconic arrangements(b)Alkul 1984](a)Atomic arrangements(c)Functional arrangements(b)CO_3(b)ds$		(a)	HF	(b)	HI	$\mathcal{O}_1$			incooline and in	ance	•	
142.Geometry of ammonia molecule and the hybridization of nitrogen involved in it are(a) $sp^3$ -hybridization and tetrahedral geometry(a) $sp^3$ -hybridization and istorted tetrahedral geometry(b) $sp^3$ -hybridization and triangular geometry(c) $sp^2$ -hybridization and triangular geometry(a) $CH_4$ (b) $NH_3$ (d) None of these(c) $H_2O$ (d) $HF$ 143.Be in $BeCl_2$ undergoes[MH CET 2004]3.Resonance is due to[NCERT 1981; Kurukshetra CEE 1998](a) Diagonal hybridization (b) Trigonal hybridization (c) Tetrahedral hybridization (d) No hybridization (d) No hybridization (d) No hybridization (e) $CS_2$ (b) $CO_2$ Resonance is due to[NCERT 1981; Kurukshetra CEE 1998](a) $CO_3$ (b) $CO_2$ (c) $Migration of protons$ (c) Migration of protons144.Which of the following is non-linear molecule (c) $CS_2$ (d) $BeCl_2$ 4.Resonating structures have different (d) Migration of protons145.The trigonal bipyramial geometry results from the hybridisation (a) $dsp^3$ or $sp^3d$ (b) $dsp^2$ or $sp^2d$ (JAMU 1984)		(c)	$CH_4$	(d)	PH <sub>3</sub>		1.	Which	one in the following is n	ot the 1	resonance struc	ture of $CO_2$
Involved in it are[Mill CET 2004](a) $sp^3$ -hybridization and tetrahedral geometry(b) $sp^3$ -hybridization and distorted tetrahedral geometry(c) $*O \equiv C - O^-$ (d) $O \equiv C = O$ (b) $sp^3$ -hybridization and distorted tetrahedral geometry(c) $sp^2$ -hybridization and triangular geometry(a) $CH_4$ (b) $NH_3$ (d) None of these(c) $H_2O$ (d) $HF$ 143. Be in BeCl_2 undergoes[MH CET 2004]3.Resonance is due to[NCERT 198]; Kurukshetra CEE 1998](a) Diagonal hybridization(a) Delocalization of <i>ji</i> electrons(b) Delocalization of <i>ji</i> electrons(c) Migration of <i>fi</i> atoms(d) No hybridization(d) No hybridization(e) Migration of <i>fi</i> atoms(f) Migration of <i>fi</i> atoms(a) $CO_3$ (b) $CO_2$ (c) $Functional groups$ (d) Alkyl groups(a) $dsp^3$ or $sp^3d$ (b) $dsp^2$ or $sp^2d$ (a) Atomic arrangements(b) Electronic arrangements(c) Functional groups(d) Alkyl groups(a) Atomic arrangements(b) Electronic arrangements(c) Functional groups(d) Alkyl groups(c) Functional groups(d) Alkyl groups	142.	Geor	metry of ammonia m	olecule and	the hybridiz	ation of nitrogen		(a)	O = C = O	(b)	$^{-}O - C \equiv O^{+}$	-
(a) $sp^2$ -hybridization and distorted tetrahedral geometry2.Which of the following molecule contains one pair of non-bonding electrons(b) $sp^3$ -hybridization and triangular geometry(c) $sp^2$ -hybridization and triangular geometry(a) $CH_4$ (b) $NH_3$ (d)None of these(c) $H_2O$ (d) $HF$ 143.Be in $BeCl_2$ undergoes[MH CET 2004]3.Resonance is due to[NCERT 1981; Kurukshetra CEE 1998](a)Diagonal hybridization(c)Tetrahedral hybridization(a)Delocalization of sigma electrons(b)Trigonal hybridization(c)Migration of protons(d)Migration of protons(d)No hybridization(d) $BeCl_2$ (d) $BeCl_2$ (d)(a) $CO_3$ (b) $CO_2$ (d) $Atomic arrangements$ (b)Electronic arrangements(c) $CS_2$ (d) $BeCl_2$ (d) $Atomic arrangements$ (b)Electronic arrangements(a) $dsp^3$ or $sp^3d$ (b) $dsp^2$ or $sp^2d$ [AMU 1984]		(2)	$sn^3$ -hybridization a	nd tetrahedr	al geometry	[MITCET 2004]		(c) .	$^{+}O \equiv C - O^{-}$	(d)	$O \equiv C = O$	
(b) $sp^2$ -hybridization and triangular geometryelectrons(c) $sp^2$ -hybridization and triangular geometry(a) $CH_4$ (b) $NH_3$ (d) None of these(c) $H_2O$ (d) $HF$ 143. $Be$ in $BeCl_2$ undergoes[MH CET 2004]3.Resonance is due to[NCERT 1981; Kurukshetra CEE 1998](a) Diagonal hybridization(b) Trigonal hybridization(c) H_2O(d) $HF$ (d) No hybridization(c) Tetrahedral hybridization(b) Delocalization of <i>sigma</i> electrons(d) No hybridization(c) Migration of <i>H</i> atoms(c) Migration of protons(d) No hybridization(b) $CO_2$ (d) Migration of protons(a) $CO_3$ (b) $CO_2$ (a) Atomic arrangements(b) Electronic arrangements(c) $CS_2$ (d) $BeCl_2$ (a) Atomic arrangements(b) Electronic arrangements(a) $dsp^3$ or $sp^3d$ (b) $dsp^2$ or $sp^2d$ [AMU 1984]		(a) (L)	$sp^3$ hubeidization a		a geometry		2.	Which	of the following molecu	le cont	ains one pair o	of non-bonding
(c) $sp$ -hybridization and triangular geometry(d) None of these(e) $HII_3$ (d) None of these(c) $H_2O$ (d) $HF$ 143. Be in BeCl_2 undergoes[MH CET 2004]3.Resonance is due to[NCERT 1981; Kurukshetra CEE 1998](a) Diagonal hybridization(b) Trigonal hybridization(c) $H_2O$ (d) $HF$ (d) No hybridization(e) Trigonal hybridization(f) CERT 1981; Kurukshetra CEE 1998](a) No hybridization(f) CERT 1981; Kurukshetra CEE 1998](a) CO_3(b) CO_2(c) CS_2(f) BeCl_2(d) BeCl_2(f) CERT 1981; Kurukshetra CEE 1998](a) Acomic arrangements(f) Delocalization of protons(f) CO_3(b) CO_2(c) CS_2(f) BeCl_2(f) CS_2(g) BeCl_2(g) dsp <sup>3</sup> or sp <sup>3</sup> d(h) dsp <sup>2</sup> or sp <sup>2</sup> d(h) dsp <sup>3</sup> or sp <sup>3</sup> d(h) dsp <sup>2</sup> or sp <sup>2</sup> d(h) Migration formal negative charge is on(h) Alkyl 1984]		(0)			tetranedrai g	eometry		(a)	CH .	( <b>b</b> )	NH .	
(d) Note of the (d) Part of the (d) Part(e) $H_2O$ (d) $HT$ 143. Be in BeCl_2 undergoes (a) Diagonal hybridization (b) Trigonal hybridization (c) Tetrahedral hybridization (d) No hybridization (d) No hybridization[MH CET 2004] (a) Delocalization of sigma electrons (b) Delocalization of pi electrons (c) Migration of protons144. Which of the following is non-linear molecule (a) $CO_3$ (c) $CS_2$ [DCE 2003] (d) $BeCl_2$ (a) Atomic arrangements (c) Functional groups145. The trigonal bipyramidal geometry results from the hybridisation (a) $dsp^3$ or $sp^3d$ (b) $dsp^2$ or $sp^2d$ (c) $H_2O$ (d) $H_1C$ 145. The trigonal bipyramidal geometry results from the hybridisation (a) $dsp^3$ or $sp^3d$ (b) $dsp^2$ or $sp^2d$ (c) Functional groups (d) Alkyl groups		(c) (d)	$sp^-$ -hybridization a	nd triangular	geometry			(a) (a)		(J)	HE	
(a) Diagonal hybridization (b) Trigonal hybridization (c) Tetrahedral hybridization (d) No hybridization (d) No hybridization (d) No hybridization (e) $CO_3$ (c) $CS_2$ (a) $CO_2$ (b) $CO_2$ (b) $CO_2$ (c) $CS_2$ (c) $ES_2$ (d) $BeCl_2$ (c) $EIectronic arrangements$ (d) $Becl_2$ (c) Functional groups (d) Alkyl groups(d) Alkyl groups <b>145.</b> The trigonal bipyramidal geometry results from the hybridisation (a) $dsp^3$ or $sp^3d$ (b) $dsp^2$ or $sp^2d$ (c) Functional groups (d) Alkyl groups(d) Alkyl groups (d) Alkyl groups	143.	Be	in $BeCl_2$ undergoe	s		[MH CET 2004]	2	Recon	$n_2 o$	(u) [NC	111 TEPT 1081. Kumuk	ahatra CEE 1009]
(b) Trigonal hybridization(b) Trigonal hybridization(c) Tetrahedral hybridization(c) Tetrahedral hybridization(c) Migration of $pi$ electrons(d) No hybridization(d) No hybridization(d) Migration of protons144.Which of the following is non-linear molecule[DCE 2003](a) $CO_3$ (b) $CO_2$ (c) $CS_2$ (c) $CS_2$ (d) $BeCl_2$ (d) $Atomic arrangements$ (b) Electronic arrangements(c) $CS_2$ (d) $BeCl_2$ (a) $dsp^3$ or $sp^3d$ (b) $dsp^2$ or $sp^2d$ (b) $dsp^2$ or $sp^2d$ (Alkyl groups)(a) $dsp^3$ or $sp^3d$ (b) $dsp^2$ or $sp^2d$		(a)	Diagonal hybridizatic	m			3.	(a) [	Delocalization of <i>sigma</i> ele	ctrons	2011 1901, Kuluk	
(c) Tetrahedral hybridization(c) Migration of H atoms(d) No hybridization(d) No hybridization144.Which of the following is non-linear molecule[DCE 2003](a) $CO_3$ (b) $CO_2$ (c) $CS_2$ (d) $BeCl_2$ (d) $Atomic arrangements$ (b) $Electronic arrangements$ (c) $CS_2$ (d) $BeCl_2$ (a) $dsp^3$ or $sp^3d$ (b) $dsp^2$ or $sp^2d$ (c) $Atomic arrangements$ (c) Functional groups(d) $Atomic arrangements$ (c) Functional groups(c) $Etronic arrangements$ (c) Functional groups(c) $Atomic arrangements$ (c) Functional groups(c) $Atomic arrangements$ (c) Functional groups(c) $Atomic arrangements$ (c) $Atomic arrangements(c) Atomic arrangements(c) Atomic arrangements(c) Atomic arrangements(c) Atomic arrangements(c) Atomic arra$		(b)	Trigonal hybridizatio	n				(b) [	Delocalization of <i>pi</i> electro	ns		
(d) No information(d) No information144.Which of the following is non-linear molecule[DCE 2003](a) $CO_3$ (b) $CO_2$ (c) $CS_2$ (d) $BeCl_2$ (d) $Migration of protons(e) CS_2(d) BeCl_2(f) The trigonal bipyramidal geometry results from the hybridisation [UPSEAT 2904](a) dsp^3 or sp^3d(b) dsp^2 or sp^2d(c) CS_2(c) Sp^2 or sp^2d(c) CS_2(c) Sp^2 or sp^2d(c) CS_2(c) Sp^2 or sp^2d$		(c) (d)	Tetrahedral hybridiza	ation				(c) N	Aigration of H atoms			
(a) $CO_3$ (b) $CO_2$ (c) $CS_2$ (d) $BeCl_2$ (a) $dsp^3$ or $sp^3d$ (b) $dsp^2$ or $sp^2d$ (b) $CO_2$ (c) $CS_2$ (c) $CS_2$ (c) $BeCl_2$ (c) $Functional groups$ (c) $Functional groups$ (c) $Alkyl$ groups (c) $Functional groups$ (c) $Alkyl$ $Becl_2$ (c) $Functional groups$ (c) $Alkyl$ $Functional groups$ (c) $Alkyl$ $Alkyl$ $Becl_2$ (c) $Functional groups$ (c) $Alkyl$ $Alk$	144.	Wh	ich of the following is	non-linear n	nolecule	[DCE 2003]		(d) N	Aigration of protons			
(c) $CS_2$ (d) $BeCl_2$ (c) Functional groups (d) Alkyl groups 145. The trigonal bipyramidal geometry results from the hybridisation[ <b>UPSEAT 29.04</b> ] (a) $dsp^3$ or $sp^3d$ (b) $dsp^2$ or $sp^2d$ [AMU 1984]		(a)	CO <sub>3</sub>	(b)	$CO_2$		4.	Reson	ating structures have diffe	erent	[AMU 1983] Electropic area	ngemente
<b>145.</b> The trigonal bipyramidal geometry results from the hybridisation [ <b>UPSEAT 29:04</b> ] In the cyanide ion, the formal negative charge is on (a) $dsp^3$ or $sp^3d$ (b) $dsp^2$ or $sp^2d$ [AMU 1984]		(c)	$CS_2$	(d)	$BeCl_2$			(a) F	Functional groups	(d)	Alkyl groups	ingements
(a) $dsp^3$ or $sp^3d$ (b) $dsp^2$ or $sp^2d$ [AMU 1984]	145.	The	trigonal bipyramidal g	geometry res	ults from the	hybridisation[ <b>UPSE</b>	AT 2904]	In the	cyanide ion, the formal n	egative	charge is on	
		(a)	$dsp^3$ or $sp^3d$	(b)	$dsp^2$ or $s$	$p^2d$						[AMU 1984]

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JNIVI Elf s	ERSAL	116 Chemical Bonding					
	(a)	С		(c)	PF <sub>3</sub>	(d)	NH <sub>3</sub>
	(b)	Ν	4.	Whic	h has the least bond ang	le	[NCERT 1973;
	(c)	Both C and N			D	PMT 1990	0; CBSE PMT 1990; UPSEAT 2003]
	(d)	Resonate between C and N		(a)	NH <sub>3</sub>	(b)	BeF <sub>2</sub>
	Whi	ch does not show resonance [CPMT 1990]		(c)	$H_2O$	(d)	$CH_4$
	(a)	Benzene (b) Aniline	5.	ln co	mpound $X$ all the bond	1 angles a	are exactly $109^{\circ}28'$ . X is
	(c)	Ethyl amine (d) Toluene	0.	(a)	Chloromethane	(h)	lodoform
	The	enolic form of acetone contains		(c)	Carbon tetrachloride	(d)	Chloroform
		[IIT 1990; Bihar MEE 1997]	6	The	shape of $SQ_{1}^{2-}$ ion is		
	(a)	9 sigma bonds, 1 pi bond and 2 lone pairs	0.	The .		1982: DP/	MT 1983, 84, 96: Bihar MEE 1997]
	(b)	8 sigma bonds, 2 pi bonds and 2 lone pairs		(a)	Square planar	(b)	Tetrahedral
	(c)	10 sigma bonds, 1 pi bond and 1 lone pair		(c)	Trigonal bipyramidal	(d)	Hexagonal
	(d)	9 sigma bonds, 2 pi bonds and 1 lone pair	7.	Whic	h of the following molec	ules has	one lone pair of electrons on
	Poin	nt out incorrect statement about resonance		the c	entral atom	(EAM	ACET 1080. AMII 1082. MNR 1080]
		[MP PET 1997]		(a)	$H_{2}O$	(b)	NH 2
	(a)	Resonance structures should have equal energy		(-) (a)	CH	(d)	PC1
	(b)	In resonance structures, the constituent atoms should be in the	0			(u) 1	
	(c)	n resonance structures, there should not be the same number	8.	Of th	te following compounds,	the one r	MP PMT 1985; AllMS 1996]
		of electron pairs		(a)	NH <sub>2</sub>	(b)	CH <sub>4</sub>
	(d)	Resonance structures should differ only in the location of		(c)	$C_2H_2$	(d)	$H_2O$
		electrons around the constituent atoms	9.	XeF	7 <sub>6</sub> is		
	The	number of possible resonance structures for $CO_3^{2-}$ is		(a)	Octahedral	(b)	Distorted octahedral
		[MP PMT 2000]	(	(c)	Planar	(d)	Tetrahedral
	(a)	2 (b) 3	10.	Whic	h has maximum bond an	gle	[CPMT 1993]
	(c)	6 (d) 9	$\bigcirc$	(a)	CHF <sub>3</sub>		
	Reso	Definition of initiate ion is [RPET 2000] $-1/2 O_{\text{comm}} N_{\text{comm}} O_{\text{comm}}^{-1/2} (h) = -2/3 O_{\text{comm}} N_{\text{comm}} O_{\text{comm}}^{-2/3}$		(b)	CHCl <sub>3</sub>		
	(d)			(c)	CHBr <sub>3</sub>		
		$ : _{-1/2}$ : $-2/3$		(d)	All have maximum bond	angle	
			11.	Of th	ne following species the o NCERT 1981; MP PMT	one havin [ <b>1994</b> ]	ng a square planar structure is
	(c)	N = O = N = O = O = O = O = O = O = O =		(a)	$NH^+_4$	(b)	$BF_{\epsilon}^{-}$
				(u)	N E	(1)	
		O <sup>-1/3</sup>		(c)	XeF <sub>4</sub>	(d)	SCl <sub>4</sub>
	CO	$_{3}^{2-}$ anion has which of the following characteristics	12.	ln w bond	hich of the following is s greatest	the ang	gle between the two covalent
	(a)	Bonds of unequal length				N!] ווד	CERT 1975; AMU 1982; MNR 1987; F 1981; CPMT 1988; MP PMT 1994]
	(b)	<i>sp</i> <sup>2</sup> hybridization of <i>C</i> atom		(a)	$CO_2$	(b)	$CH_4$
	(c)	Resonance stabilization		(c)	NH	(d)	НО
	(d)	Same bond angles		(C)	1	1 1 .	
			13.	As th	ne s-character of hybridize	eu ordita	Increases, the bond angle
		VOLINTIEOTY		(a)	Does not change	(d)	Recomes zero
	The	structure of $\begin{bmatrix} C_{H} \\ H \\ 0 \end{bmatrix}^{++}$ ion is	14	(C) Val	Z malagula is	(u)	
	The	[N/CEDT 1090. MD DAT 1090]	14.	лег	2 molecule is	/1 X	[BHU 1982]
	(a)	Square planar (b) Tetrahedral		(a)	Linear	(b)	Triangular planar
	(c)	Distorted rectangle (d) Octahedral	15	(c)	ryramidal	(b)	Square planar
	The	bond angle in $PH_3$ would be expected to be close to	ı <u></u> .	speci	es	one do	
	(a)	$90^{\circ}$ (b) $105^{\circ}$		()	$PO^{3-} SO^{2-} CO^{-}$	(1)	$C N^{-} N C^{2-}$
	(a) (c)	$109^{\circ}$ (d) $120^{\circ}$		(a)	$10_4$ , $50_4$ , $Cl0_4$	(b)	$v_1 v_2, v_2$
	In w	hich molecule are all atoms coplanar [MP PMT 1004]		(c)	$SO_3^{2^-}, CO_3^{2^-}, NO_3^-$	(d)	$BO_3^{3-}, CO_3^{2-}, NO_3^{-}$

			Chemical Bonding 117
	[NCERT 1982]		(b) $C_2H_2 > NH_3 > H_2O < CH_4$
	(a) Carbon monoxide (b) Molecular nitrogen		(c) $NH_3 > H_2O > CH_4 < C_2H_2$
	(c) Molecular oxygen (d) Hydrogen peroxide		(d) $H_2O < NH_3 > CH_4 < C_2H_2$
17.	<i>H</i> <sub>2</sub> <i>O</i> is [MADT Bihar 1983]	28.	Which compound has bond angle nearly to 90°
	(a) A linear triatomic molecule		[Pb. PMT 2001]
	(b) A bent (angular) triatomic molecule		(a) $H_2O$ (b) $H_2S$ (c) $NH$ (d) $CH$
	(d) None of these	29	A lone pair of electrons in an atom implies $[KCET 2002]$
10	Pand and between two hybrid orbitals is $105^{\circ}$ %, corbital	29.	(a) A pair of valence electrons not involved in bonding
10.	character of hybrid orbital is [MP PMT 1986]		(b) A pair of electrons involved in bonding
	(a) Between $20 - 21\%$ (b) Between $19 - 20\%$		(c) A pair of electrons
	(c) Between $21 - 22\%$ (d) Between $22 - 23\%$		(d) A pair of valence electrons
19.	The bond angle between $H - O - H$ in ice is closest to	30.	The bond angle of water is 104.5° due to[CPMT 2002](a) Repulsion between lone pair and bond pair
	[CPMT 1989; UPSEAT 2002]		(b) $sp^3$ hybridization of $Q$
	(a) $120^{\circ}28'$ (b) $60^{\circ}$		(c) Bonding of $H_{2}O$
	(c) $90^{\circ}$ (d) $105^{\circ}$		(d) Higher electronegativity of <i>Q</i>
20.	Which of the following molecules does not have a linear arrangement of atoms       [CBSE PMT 1989]	31.	The correct sequence of decrease in the bond angle of the following hybrides is [MP PET 2002]
	(a) $H_2S$ (b) $C_2H_2$		(a) $NH_2 > PH_2 > AsH_2 > SbH_2$
	(c) $BeH_2$ (d) $CO_2$		(b) $A = A = A = A = A = A = A = A = A = A $
21.	$BCl_3$ is a planar molecule while $NCl_3$ is pyramidal, because		(c) $SbH_3 > AsH_3 > PH_3 > NH_3$ (c) $SbH_3 > AsH_3 > PH_3 > NH_3$
	(a) $BCl_3$ has no lone pair of electrons but $NCl_3$ has a lone pair of electrons	(	(d) $PH_3 > NH_3 > AsH_3 > SbH_3$
	(b) $B-Cl$ bond is more polar than $N-Cl$ bond	32.	Central atom of the following compound has one lone pair of electrons and
	(c) Nitrogen atom is smaller than boron atom		(-) <i>H</i> S (-) <i>H</i> S (-) <i>H</i> S (-)
22	(d) $N - Cl$ bond is more covalent than $B - Cl$ bond The isoelectronic pair is [AllMS 2006]		$ \begin{array}{c} (a) & \Pi_2 \\ (b) & \Pi_2 \\ (b) & \Pi_2 \\ (b) & \Pi_2 \\ (c) & \Pi_2 $
22.	(a) $CL \cap ICL$ (b) $ICL \cap CL \cap$		(c) $NH_3$ (d) $BF_3$
	(a) $Cl_2O, RCl_2$ (b) $Rcl_2, ClO_2$ (c) $IF_2^+, I_3^-$ (d) $ClO_2^-, CIF_2^+$	33.	Among $KO_2$ , $AlO_2^-$ , $BaO_2$ and $NO_2^+$ unpaired electron is present in [MP PET 2003]
23.	According to VSEPR theory, the most probable shape of the		(a) $NO^+$ and $BaO$ (b) $KO$ and $AlO^-$
	molecule having 4 electron pairs in the outer shell of the central		(a) $NO_2$ and $DuO_2$ (b) $NO_2$ and $NO_2$
	atom is [MP PET 1996, 2001]		(c) $\mathcal{K}\mathcal{O}_2$ only (d) $\mathcal{B}\mathcal{U}\mathcal{O}_2$ only
	(c) Hexahedral (d) Octahedral	34.	True order of bond angle is [RPET 2003]
24.	The molecular shapes of $SF_4$ , $CF_4$ and $XeF_4$ are		(a) $H_2 O > H_2 S > H_2 S e > H_2 Ie$
	[AIEEE 2005]		(b) $H_2Te > H_2Se > H_2S > H_2O$
	(a) The same with 2, 0 and 1 lone pairs of electrons on the central atom, respectively		(c) $H_2S > H_2O > H_2Se > H_2Te$
	(b) The same with 1, 1 and 1 lone pair of electrons on the central		(d) $H_2O > H_2S > H_2Te > H_2Se$
	atoms, respectively	35.	Which of the following has not a lone pair over the central atom
	(c) Different with 0, 1 and 2 lone pairs of electrons on the central atom. respectively		(a) $NH_3$ (b) $PH_3$
	(d) Different with 1, 0 and 2 lone pairs of electrons on the central		(c) $BF_3$ (d) $PCl_3$
25	atom, respectively	36.	In $BrF_3$ molecule, the lone pairs occupy equatorial positions to
<b>45</b> .	which of the following species is planal [] $PMEK [997]$		minimize   [CBSE PMT 2004]
	(a) $CO_3$ (b) $NH_2$		(a) Lone pair- lone pair repuilsion and lone pair-bond pair repulsion
	(c) $\Gamma C I_3$ (d) None of these		(b) Lone pair- lone pair repulsion only
26.	The shape of $CH_3^+$ species is [RPET 1999]		(c) Lone pair- bond pair repulsion only
	(a) Tetrahedral (b) Square planar		(d) Bond pair- bond pair repulsion only
27.	(c) Inigonal planar (d) Linear Which of the following is the correct reducing order of bond-angle	37.	$H_2O$ is dipolar, whereas $BeF_2$ is not. It is because [BHU 2000]
-,.	(a) $NH_3 < CH_4 < C_2H_2 < H_2O$		[CBSE PMT 1989; 2004]
			(a) $\Pi_2 O$ is linear and $Der_2$ is angular

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	(b) $H_2O$ is angular and $Bell$	$F_2$ is lin	near		(a)	<i>O</i> <sub>2</sub>	(b)	$O_2^{-2}$	
	(c) The electornegativity of $F$	is great	er than that of O		(c)	$O_{2}^{+1}$	(b)	$Q_{2}^{-1}$	$\mathbf{O}$
	(d) $H_2O$ involves hydrogen	bonding	g whereas $BeF_2$ is a discrete	5.	The	bond order is maximum	n in	02	
-0	molecule			0.		[A]	IMS 1983, 85	5; CBSE PMT 199	4; MP PET 2002]
38.	Maximum bond angle is presen	t in	[BVP 2004]		(a)	$O_2$	(b)	$O_2^{-1}$	
	(a) $BCl_3$	(Ь)	BBr <sub>3</sub>		(c)	$O^{+1}$	(d)	$0^{-2}$	
	(c) $BF_3$	(d)	Same for all	6	(C) W/b;	$O_2$	(u)	f horon door i	not avist in the
39.	The shape of a molecule of $N$	${H}_3$ , in	which central atoms contains	0.	free	form	inpounds o	Doron does i	iot exist in the
	lone pair of electron, is		[MHCET 2003]		(a)	BCl <sub>3</sub>	(b)	BF <sub>3</sub>	
	(a) Tetrahedral (c) Square planar	(b) (d)	Planar trigonal Pyramidal		(c)	BBr <sub>3</sub>	(d)	$BH_3$	
40.	The largest bond angle is in	(u)	[DCE 2002; MNR 1984]	7.	Mol	ecular orbital theory wa	s developed	I mainly by	
	(a) $AsH_3$	(b)	NH <sub>3</sub>				N ·	[BHU 198	7; Pb. CET 2003]
	(c) $H_2O$	(d)	PH <sub>3</sub>		(a)	Pauling	(b)	Pauling and S	ater
41.	The bond angle in ammonia mo	olecule	is [EAMCET 1980]	0	(c) Tl	Mulliken	(d)	Thomson 1	
	(a) 91°8′	(b)	93°3'	8.	The (a)	The difference betwee	ile is given en the nur	by nber of electro	[NCERT 1984]
	(c) $106^{\circ}45'$	(d)	109°28'		(-)	and antibonding orbita	als		8
42.	Which of the following gives	correct	arrangement of compounds		(b)	Total number of electr	ons in bond	ding and antibo	onding orbitals
	involved based on their bond st	rength	[BH11 2005]		(c)	bonding and antibondi	between	the number o	of electrons in
	(a) HF > HCl > HBr > HI		[5:14 =000]		(d)	Half the difference bet	ween the n	umber of elect	rons in bonding
	(b) $HI > HBr > HCI > HF$					and antibonding electr	rons		
	(c) $HF > HBr > HCl > Hl$ (d) $HCl > HF > HBr > Hl$			9.	Uxy	gen molecule is parama	gnetic beca	use [NCER	T 1984; IIT 1984]
43.	Which one has a pyramidal stru	icture	[CBSE PMT 1990]		(a)	Bonding electrons are	more than	antibonding ele	ectrons
	(a) $CH_4$	(b)	NH <sub>3</sub>	.U	(b)	Contains unpaired elec	trons		
	(c) $H_2O$	(d)	<i>CO</i> <sub>2</sub>		(c) (d)	Bonding electrons are	equal to an	tibonding elect	rons
44.	Among the following the pair isostructural is	r in wł	nich the two species are not [CBSE PMT 2004]	10.	Whi	ich one is paramagnetic	from the fo	ollowing [ <b>11T 1989;</b>	CBSE PMT 1995]
	(a) $BH_4^-$ and $NH_4^+$	(b)	$PF_6$ and $SF_6$		(a)	$O_{2}^{-}$	(b)	NO	
	(c) $SiF_4$ and $SF_4$	(d)	$IO_3^-$ and $XeO_3$		(c)	Both (a) and (b)	(d)	CN <sup>-</sup>	
45.	The maximum number of $90^\circ$ of electrons is observed in	angles [ <b>AIE</b> I	between bond pair-bond pair EE 2004]	11.	The (a)	bond order in $N_2^+$ ion	n is (b)	2	[Pb. CET 2004]
	(a) $dsp^2$ hybridization	(b)	sp <sup>3</sup> d hybridization		(c)	2.5	(d)	3	
	(c) $dsp^3$ hybridization	(d)	$sp^{3}d^{2}$ hybridization	12.	Out	of the following which	has smalles	t bond length	
	· / · ·				()	0	(1)	$O^+$	[KPM1 1997]
	Molecular or	bital	theory		(a)	$O_2$	(b)		
1	Bond order is a concept in the	molec	ular orbital theory. It depends		(c)	$O_{2}^{-}$	(d)	$O_2^{2-}$	
	on the number of electrons in	the bon	ding and antibonding orbitals.	13.	Whi	ich of the following mole	ecule is par	amagnetic	00. BDMT 2000]
	Which of the following stateme	nts is ti 	rue about it ? The bond order[	A11MS 1980]	(a)	Chlorine	(b)	Nitrogen	<b>599, I</b> a Mi 2000]
	(a) Can have a negative quant (b) Has always an integral value	ity			(c)	Oxygen	(d)	Hydrogen	
	(c) Can assume any positiv	ve or	integral or fractional value	14.	Whi	ich molecule has the hig	hest bond o	order	
	including zero		C C		(a)	N <sub>2</sub>	(b)		
	(d) Is a non zero quantity				(c)	$He_2$	(d)	$O_2$	
2.	The bond order of <i>NO</i> molec	ule is	[MP PET 1996]	15.	The	molecular electronic co	nfiguration	of $H_2^-$ ion is	
	(a) 1 (c) 2.5	(d)	2 3		(a)	$(\sigma 1s)^2$	(b)	$(\sigma 1s)^2 (\sigma^x 1)$	$(s)^2$
3.	When two atomic orbitals coml	bine the	ey form		(c)	$(\sigma_1 s)^2 (\sigma_1 s)^1$	<b>(k</b> )	$(\sigma 1s)^3$	
	(a) One molecular orbital	(b)	Two molecular orbital	16.	The	paramagnetic nature of	of oxvgen 1	nolecule is he	st explained on
	(c) Three molecular orbital	(d)	Four molecular orbital		the	basis of			[BHU 1996]
4.	Which of the following species	is the le	east stable		(a)	Valence bond theory	(b)	Resonance	

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	(c) Molecular orbital the	ory (d) Hybridiz	zation		(c)	Equal to that of 2	s orbital		
17.	In which case the bond	length is minimum	between carbon and		(d)	Double that of 2s	orbital		
	$(a)  CH \cdot NH$	(b) $C_{1}H_{2}$	CH = NOH	29.	ln t	he electronic structu	ire of acetic ac	id, there are	
	(a) $CH_3 I M_2$	(d)  CH  CH  CH  CH  CH  CH  CH  C	N						[AMU 1983]
18	(c) $CH_3 COMT_2$ Which one of the following	(d) $CH_3C$	tic in nature		(a)	16 shared and 8 u	nshared electro	ns	
10.	which one of the following	species is diamagne	[AIEEE 2005]		(b)	8 shared and 16 u	nshared electro	ns	
	(a) $He_2^+$	(b) <i>H</i>			(c)	12 shared and 12 u	nshared electro	ons	
	(c) $H_{2}^{+}$	(d) $H_2^-$			(d)	18 shared and 6 u	ishared electro	ns 1 1 1	
19.	Which one of the followin behaviour	g oxides is expected	exhibit paramagnetic [ <b>CBSE PMT 2005</b> ]	30.	orb	ich of the following	g does not ex [AF	<b>MC 1990; MP PM</b>	is of molecular I <b>T 1996</b> ]
	(a) $CO_2$	(b) $SO_2$			(a)	$H_{2}^{+}$	(b)	$He_2^+$	
	(c) $ClO_2$	(d) $SiO_2$			(c)	He <sub>2</sub>	(d)	Li <sub>2</sub>	
20.	The bond order in $N_2$ m	olecule is		31.	ln	$P_4 O_{10}$ , the num	nber of oxyg	en atoms atta	ached to each
	2	[CBSE 1995; Pb. P	MT 1999; MP PET 1997]	•	pho	sphorus atom is			[IIT 1995]
	(a) 1	(b) 2			(a)	2	(b)	3	
21	(c) 3 Which one is paramagnetic	(d) 4 and has the bond of	rder 1/2		(c)	4	(d)	2.5	
21.	which one is paramagnetic		[NCERT 1983]	32.	Of	the following statem	ents which one	e is correct	
	(a) $O_2$	(b) $N_2$			(a)	Oxygen and nitri because both cont	ic oxide mole ain unpaired el	cules are both ectrons	1 paramagnetic
22	(c) $\Gamma_2$ When two stoms of shi	(d) $H_2$	rm ana malagula of		(b)	Oxygen and nitr	ic oxide mol	ecules are bot	th diamagnetic
22.	chlorine gas, the energy of	the molecule	[AMU 1982]			because both cont	ain no unpaire	d electrons	
	(a) Greater than that of s	separate atoms			(c)	Oxygen is parama while nitric oxid	gnetic because e is diamagn	it contains unp etic because i	aired electrons
	(b) Equal to that of separ	ate atoms				unpaired electrons	e io alamagn	ene beeddoe i	e contanto ne
	(c) Lower than that of se (d) None of the above sta	parate atoms ntement is correct		()	(d)	Oxygen is diama	agnetic becau	se it contains	no unpaired
23.	An atom of an element $A$	has three electrons	in its outermost shell <			electrons, while ni	tric oxide is pa	ramagnetic beca	ause it contains
	and that of <i>B</i> has six elec	trons in the outermo	ost shell. The formula			an unpaired electr			1 1
	of the compound between	these two will be [CPM	T 1974, 84; RPMT 1999]	33.	Acc	ording to the mole	cular orbital t	heory, the bond	1 order in $C_2$
	(a) $A_3B_4$	(b) $A_2 B_3$			(a)		(b)	1	
	(c) $A_3 B_2$	(d) $A_2 B$			(a) (c)	2	(d)	3	
24.	The bond order of individu	1al carbon-carbon bo	nds in benzene is	34.	The	- mo <b>ll@Tul9\$0</b> drbital.c	onfiguration of	a diatomic mol	lecule is
	<ul><li>(a) One</li><li>(c) Between 1 and 2</li></ul>	(b) Two (d) One and	l two alternately	01	σ	$1s^2 \sigma^* 1s^2 \sigma 2s^2$	$c^{*}\sigma^{*}2s^{2}\sigma^{2}$	$p_{x}^{2} \begin{cases} \pi 2 p_{y}^{2} \\ 2 \end{pmatrix}$	
25.	$PCl_5$ exists but $NCl_5$ de	oes not because						$\pi 2p_z^2$	
	(a) Nitrogen has no vaca	EAMCET I	977; MP PET/PMT 1988]		lts l	bond order is			
	(b) $NCl_5$ is unstable				(a)	3	(b)	2.5	
	(c) Nitrogen atom is muc	ch smaller			(c)	2	(d)	1	
26.	(d) Nitrogen is highly ine Paramagnetism is exhibited	rt I by molecules		35.	The the	e difference in energ combining atomic o	y between the rbitals is called	molecular orbi I	ital formed and
	(a) Not attracted into a r	[NCE	RT 1979; MP PET 2002]		(a)	Bond energy	(b)	Activation ene	rgy
	(b) Containing only paire	d electrons			(c)	Stabilization energ	y (d)	Destabilization	1 energy
	<ul><li>(c) Carrying a positive ch</li><li>(d) Containing unpaired</li></ul>	narge electrons		36.	Acc mol	ording to molecula lecule is due to pres	r orbital theor ence of	y, the paramag [ <b>MP PMT 1997</b> ]	, net is m of $O_2$
27.	Which one of the following	s is paramagnetic	[DPMT 1985]		(a)	Unpaired electrons	s in the bondin	g $\sigma$ molecular	orbital
	(a) $H_2O$	(b) $NO_2$			(b)	Unpaired electrons	s in the antibor	nding $\sigma$ molecu	ılar orbital
	(c) $SO_2$	(d) $CO_2$			(c)	Unpaired electron	in the bonding	$\pi$ molecular	orbital
28.	The energy of a $2n$ orbita	l except hydrogen at	om is		(d)	Unpaired electrons	s in the antibor	nding $\pi$ molecu	ılar orbital
_0,			[AM1] 1982]	37.	The	bond order in $O_2^+$	is	[MP PET	1999; BHU 2001
	(a) Less than that of $2s$	orbital	[, 110 [903]		(a)	2	(b)	2.5	
	(b) More than that of 2.	e orbital			(c)	1.5	(d)	3	
	(0) more than that of 25	orona					. ,		

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38.	Which of the following is pa	ramagnetic [MP PET 1999]	50.	The number of antibonding	electron pairs in $O_2^{2-}$	molecular ion on
	(a) <i>O</i> <sub>2</sub>	(b) $CN^{-}$		the basis of molecular orbita	al theory is	
	(c) <i>CO</i>	(d) <i>NO</i> <sup>+</sup>		(a) 4	(b) 3	[FD. FM1 2000]
39.	If $N_x$ is the number of bor	ading orbitals of an atom and $N_y$ is the		(c) 2	(d) 5	
	number of antibonding or	bitals, then the molecule/atom will be	51.	The bond order of $He_2^+$ m	olecule ion is	
	(a) $N > N$	(b) $N = N$		(a) 1	(b) 2	юоо; Рь СЕТ 2001]
	(d) $N_x > N_y$	$(1)  N \leq N$		(c) $\frac{1}{2}$	$(\mathbf{d}) \stackrel{1}{=}$	
	(c) $N_x < N_y$	(d) $N_x \leq N_y$		$\frac{2}{2}$	4	
40.	Which of the following mole $(a) = \sigma^2 a$	(b) $\pi 2n$	52.	(a) CLO	$ClO^{-}$	[DPMT 2000]
	(a) 0 23	(b) $n 2p_y$		(a) $ClO_2$	(d) NO	
	(c) $\pi^* 2p_y$	(d) $\sigma^* 2p_x$	53.	In which of the following	pairs the two molecule	es have identical
41.	The number of nodal planes	' <i>d</i> ' orbital has <b>[KCET 1996</b> ]		bond order	<b>9</b>	[MP PMT 2000]
	(a) Zero	(b) One		(a) $N_2, O_2^{2+}$	(b) $N_2 O_2^-$	
12	(c) Two Atomic number of an eleme	(d) Three nt is 26. The element shows		(c) $N_2^- O_2$	(d) $O_2^+ N_2$	
		[CPMT 1996]	54.	The bond order is not three	for	[MP PMT 2001]
	(a) Ferromagnetism	(b) Diamagnetism		(a) $N_2^+$	(b) $O_2^{2+}$	
	(c) Paramagnetism	(d) None of these		(c) N <sub>2</sub>	(d) $NO^+$	
43.	What is correct sequence of $(x) = 0^+$	bond order [BHU 1997]	55.	$\ln H_2 O_2$ molecule, the ang	le between the two $O$ –	H planes is
	(a) $O_2^+ > O_2^- > O_2^-$	(b) $O_2^+ > O_2^- > O_2^-$	(	(a) 90°	(b) 101 <sup>o</sup>	
	(c) $O_2 > O_2^- > O_2^+$	(d) $O_2^- > O_2^+ > O_2$		(c) $103^{\circ}$	(d) 105°	
44.	Which bond is strongest	[RPMT 1997]	50.	Which of the following mole	cule has highest bond er	nergy [AIIMS 2002]
	(a) $F - F$	(b) $Br - F$		(a) $F-F$	(b) $C-C$	
45.	(c) $Cl - F$ Which of the following is no	(d) $I - F$	57	(c) $N - N$ Which of the following space	(d) $O - O$	mamagnatia
10.	(a) $S^{-2}$	(b) $N^{-}$	57.	(a) Copper crystals	(b) $Cu^+$	anagnetic
				(c) $Cu^{++}$	(d) $H_2$	
_	(c) $O_2^-$	(d) NO	58.	Which of the following is co	rrect for $N_2$ triple bon	d
46.	Which one of the following	molecules is paramagnetic	•	0	2 1	[CPMT 2002]
	(a) $CO_2$	(b) $SO_2$		(a) $3s$	(b) 1 <i>p</i> , 2s	
	(c) $NO$	$(d)$ $H_2O$	59.	In which of the following pa	irs molecules have bond	order three and
47	N and O are conver	trad into monomions $N^-$ and $Q^-$		are isoelectronics		[MP PET 2003]
47.	respectively, which of the following $respectively$	llowing statements is wrong		(a) $CN^-$ , $CO$	(b) $NO^+$ , $CO^+$	÷
		[CBSE PMT 1997]		(c) $CN^-$ , $O_2^+$	(d) CO, $O_2^+$	
	(a) In $N_2$ , the $N-N$ b	oond weakens	60.	Which of the following is pa	ramagnetic [MP PET 2003	5]
	(b) In $O_2$ , the $O - O_2$ b	ond order increases		(a) $O_2^+$	(b) $CN^{-}$	
	(c) $\ln O_2$ , bond length in	creases	<b>C</b> -	(c) <i>CO</i>	(d) $N_2$	1 1
	(d) $N_2^-$ becomes diamagn	etic	61.	How many bonding electron (a) 6	pairs are there in white (b) 12	phosphorous
48.	With increasing bond order,	stability of a bond		(c) 4	(d) 8	
	(a) Remains unaltered	[CET Pune 1998] (b) Decreases	62.	The atomicity of phosphoru	is is X and the $\hat{PPP}$ b	ond angle in the
	(c) Increases	(d) None of these		molecule is Y. What are X are	nd Υ [EAMCET 2003]	0 <i>°</i>
49.	Which is not paramagnetic	[DCE 1999, 2000]		(a) $A = 4, r = 90$ (c) $X = 2, V = 120^{\circ}$	(b) $X = 4, Y = 0$ (d) $Y = 2, V = 1$	0 80 <i>°</i>
	(a) 0 <sub>2</sub>	(b) $O_2^+$		(c) = 3, i = 120	$(u)  x - 2, \ I = 10$	50
	(c) $O_2^{2-}$	(d) $O_2^-$				

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63.	From elementary molecular orbital theory we can give the electronic		(b) Bond length in $NO$ is greater than in $NO^+$
	configuration of the singly positive nitrogen molecular ion $N_2^{+}$ as		(c) Bond length in NO <sup>+</sup> is greater than in NO
	(a) $\sigma(1s)^2 \sigma^*(1s)^2 \sigma(2s)^2 \sigma^*(2s)^2 \pi(2p)^4 \sigma(2p)^1$		(d) Bond length is unpredictable
	(b) $\sigma(1s)^2 \sigma^*(1s)^2 \sigma(2s)^2 \sigma^*(2s)^2 \sigma(2p)^1 \pi(2p)^3$	73.	(a) Overgen molecule (b) Boron molecule
	(c) $\sigma(1s)^2 \sigma^*(1s)^2 \sigma(2s)^2 \sigma^*(2p)^2 \pi(2p)^4$		(a) $N_{ygen}^+$ (d) None
	(d) $\sigma(1s)^2 \sigma^*(1s)^2 \sigma(2s)^2 \sigma^*(2s)^2 \sigma(2p)^2 \pi(2p)^2$		
64.	The paramagnetic property of the oxygen molecule due to the	74.	Bond energies in <i>NO</i> , <i>NO</i> and <i>NO</i> are such as
	presence of unpaired electorns present in [Kerala PMT 2004]		(a) $NO^- > NO > NO^+$ (b) $NO > NO^- > NO^+$
	(a) $(\sigma 2p_x)^1$ and $(\sigma^* 2p_x)^1$		(c) $NO^+ > NO > NO^-$ (d) $NO^+ > NO^- > NO$
	(b) $(\sigma 2p)^{1}$ and $(\pi 2p)^{1}$	75.	Which of the following is paramagnetic [UPSEAT 2004]
	(c) $(\pi * 2n)^1$ and $(\pi * 2n)^1$		(a) $B_2$ (b) $C_2$
	(b) $(-2p_y)^1 = 1 (-2p_z)^1$		(c) $N_2$ (d) $F_2$
	(d) $(\pi + 2p_y)$ and $(\pi 2p_y)$	76.	The paramagnetic molecule at ground state among the following is[ <b>UPSEAT</b>
	(e) $(\pi * 2p_z)^{i}$ and $(\pi 2p_z)^{i}$		(a) $H_2$ (b) $O_2$
65.	In $PO_4^{3-}$ ion, the formal charge on each oxygen atom and		(c) $N_2$ (d) $CO$
	P-O bond order respectively are [DPMT 2004]	77.	(a) F
	(a) $-0.75, 1.25$ (b) $-0.75, 1.0$		(c) $Br$ (d) $L$
	(c) $-0.75, 0.6$ (d) $-3, 1.25$		$(0)$ $T_2$
66.	The bond order in $CO_3^{2-}$ ion between $C-O$ is	76.	$O_2$ , $O_2$ and $O_2$ molecular species, the total number of antibonding electrons respectively are [DCE 2003]
	[Pb. PMT 2004]	(	(a) 7, 6, 8 (b) 1, 0, 2
	(d) 2210 (d) 2 (c) 1.33 (d) 2		(c) 6, 6, 6 (d) 8, 6, 8
67.	The bond order of $O_2^+$ is the same as in [CPMT 2004]	79.	Which of the following is not paramagnetic [DCE 2002] (-) $Q$ (-) $Q^{2+}$
	(a) $N_2^+$ (b) $CN^-$		(a) $O_2^{2^-}$ (b) $O_2^{-}$
	(c) $CQ$ (d) $NQ^+$	80	(c) $O_2$ (d) $O_2$ Which of the following species have maximum number of unpaired
68.	Bond order of $O_2$ is [DPMT 2004]	00.	electrons [AllMS 1983]
	(a) 2 (b) 1.5		(a) $O_2$ (b) $O_2^+$
	(c) 3 (d) 3.5		(c) $O_2^-$ (d) $O_2^{2-}$
69.	The total number of electron that takes part in forming bonds in $N_2$ is [MP PET 2004]	81.	The correct order in which the $O - O$ bond length increases in the following is [BHU 2000; CBSE PMT 2005]
	(a) 2 (b) 4		(a) $H_2O_2 < O_2 < O_3$ (b) $O_2 < H_2O_2 < O_3$
	(c) 6 (d) 10		(c) $O_2 < O_3 < H_2O_2$ (d) $O_3 < H_2O_2 < O_2$
70.	The bond length the species $O_2, O_2^+$ and $O_2^-$ are in the order of	82.	Correct MrdEF6 2004 d length is [Orissa JEE 2005]
	(a) $O_2^+ > O_2 > O_2^-$ (b) $O_2^+ > O_2^- > O_2$		(a) $CO_3^{2-} > CO_2 > CO$ (b) $CO_2 > CO > CO_3^{2-}$
	(c) $O_2 > O_2^+ > O_2^-$ (d) $O_2^- > O_2 > O_2^+$		(c) $CO > CO_2 > CO_3^{2-}$ (d) None of these
71.	According to molecular orbital theory which of the following	83.	Which of the following is paramagnetic [DPMT 2005]
	statement about the magnetic character and bond order is correct		(a) $N_2$ (b) $C_2$
	regarding $O_2^+$ [IIT JEE Screening 2004]		(c) $N_2^+$ (d) $O_2^{2-}$
	(a) Paramagnetic and bond order< $O_2$	84.	Among the following molecules which one have smallest bond angle[Orissa
	(b) Paramagnetic and bond order> $O_2$		(a) $NH_3$ (b) $PH_3$
	(c) Dimagnetic and bond order< $O_2$		(c) $H_2O$ (d) $H_2Sc$
	(d) Dimagnetic and bond order> $O_2$		(e) $H_2S$
72.	The bond order in $NO$ is 2.5 while that in $NO^+$ is 3. Which of the following statements is true for these two species		Hydrogen bonding
	[AIEEE 2004]	1.	In the following which bond will be responsible for maximun value of hydrogen bond
	(a) Bond length in $NO^+$ is equal to that in $NO$		(a) $O-H$ (b) $N-H$
	-		

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(c) $S-H$	(d) $F-H$	13.	The pairs of bases in DA	VA are held	together by
In which of the follo	ving hydrogen bond is present			[NCERT 1	978; DPMT 1985; CBSE PMT 1992]
(a) <i>H</i> <sub>2</sub>	(b) lce		(a) Hydrogen bonds	(b)	Ionic bonds
(c) Sulphur	(d) Hydrocarbon		(c) Phosphate groups	(d)	Deoxyribose groups
In the following which	h has highest boiling point [MP PMT 1989: RPMT 1997]	14.	Water has high heat of va	aporisation d	ue to [AFMC 1982]
(a) HI	(b) <i>HF</i>		(a) Covalent bonding	(b)	H - bonding
(a) $HBr$	(J) HCl		(c) Ionic bonding	(d)	None of the above
Which contains hydr	ogen bond [MP PMT 1989]	15.	In which of the following	compounds	does hydrogen bonding occur
(a) HF	(b) HCl		(a) $SiH$ .	(b)	liH
(c) HBr	(d) HI		(a) $Sim_4$	(0)	
Contrary to other h	ydrogen halides, hydrogen fluoride is a liquid		(c) HI	(d)	NH <sub>3</sub>
because	[MP PMT 1990; AMU 1983; EAMCET 1980]	16.	Which among the follow	ving compou	inds does not show hydrogen
(a) Size of $F$ atom	is small		bonding		[MP PMT 1989]
(b) <i>HF</i> is a weak a	cid		(a) Chloroform	(b)	Ethyl alcohol
(c) HF molecule	re hydrogen bonded		(c) Acetic acid	(d)	Ethyl ether
(d) Fluorine is high	y reactive	17.	Acetic acid exists as dime	er in benzene	due to [CPMT 1982]
In the following whi	h species does not contain $sn^3$ hybridization		(a) Condensation reaction	on	
	(1) CH		(b) Hydfrogen 2001ding	1	
(a) $NH_3$	(b) $CH_4$		(c) Presence of carboxy	i group	<b>h</b>
(c) $H_2O$	(d) <i>CO</i> <sub>2</sub>	10	(a) Presence of hydroge	$\alpha$ atom at $\alpha$	
As a result of <i>sp</i> by	bridization, we get [11T 1984]	18.	Which one among the fol	llowing does	not have the hydrogen bond
(a) Two mutual pe	pendicular orbitals			(1)	
(b) Two	180 <sup>0</sup>	(	(a) Prienol	(b)	Liquia IVII 3
(D) I WO ORDITALS at	100		(c) Water	(d)	Liquid HCl
(c) Four orbitals in (d) Three arbital- :	the same plane	19.	The bond that determine	s the seconda	ary structure of a protein is[NC
(u) Three orbitals 1	tionally high boiling point of water is		(a) Coordinate bond	(b)	Covalent bond
The reason for excep	DPMT 1086. NCERT 1076. AMI 1 1084. FAMCET 1070.	<b>J</b>	(c) Hydrogen bond	(d)	Ionic bond
	MP PMT 1993; AllMS 1996; KCET 2001; CPMT 2003]	20.	HCl is a gas but $HF$ is	s a low boilin	g liquid. This is because
(a) Its high specific	heat				[NCERT 1984; MP PMT 2001]
(b) Its high dielectr	c constant		(a) $H - F$ bond is stro	ng	
(c) Low ionization	of water molecules		(b) $H - F$ bond is wea	k	
(d) Hydrogen bond	ng in the molecules of water		(c) Molecules aggregate	because of l	nydrogen bonding
Which concept best	explains that <i>o</i> -nitrophenol is more volatile than		(d) $HF$ is a weak acid		
<i>p</i> -nitrophenol		21.	The relatively high boiling	g point of <i>H</i>	F is due to
[,	IIMS 1980, 82; Kurukshetra CEE 1998; MP PET 2002]				[NCERT 1984]
(a) Resonance	(b) Hyperconjugation		(a) Hydrogen bonding		
(c) Hydrogen bond	ng (d) Steric hindrence		(b) Covalent bonding		
Which contains stro	gest $H$ – bond		(c) Unshared electron p	air on F	
	[IIT 1986; MP PET 1997, 2003; UPSEAT 2001, 03]		(d) Being a halogen acid	1	
(a) $O-H$ $S$	(b) $S - HO$	22.	Water is liquid due to		[MADT Bihar 1983]
(c) $F - H \dots F$	(d) $F - HO$		(a) Hydrogen bonding	(b)	Covalent bond
Which of the followi	g compound can form hydrogen bonds		(c) Ionic bond	(d)	Vander Waals forces
	[NCERT 1978; MP PMT 1997]	23.	The maximum possible $H_2O$ molecule can parti	number of icipate is	hydrogen bonds in which an
(a) $CH_4$	(b) NaCl		2 ···· r····	MP PMT 1086	: MNR 1991: 11T 1992:MP PET 1990]
(c) CHCl <sub>3</sub>	(d) $H_2O$		(a) 1	(h)	2
Of the following hyd	ides which has the lowest boiling point		(c) 3	(d)	4
	[CBSE PMT 1987]	24.	Hydrogen bonding is may	kimum in	
(a) $NH_3$	(b) <i>PH</i> <sub>3</sub>	- 0	,	[ <b>11</b> T 1987;	MP PMT 1991; MP PET 1993, 2001
				MNR 199	5; CPMT 1999; KCET (Med.) 2002]
(c) $SbH_2$	(d) $AsH_3$		(a) Ethanol	( <b>b</b> )	Disthul athan

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Chemical Bonding 123 ELF SCOR (c) Ethyl chloride (d) Triethyl amine Ethanol and dimethyl ether form a pair of functional isomers. The 35. boiling point of ethanol is higher than that of dimethyl ether due to The hydrogen bond is strongest in 25. the presence of [AIIMS 1998] [BHU 1987; CBSE PMT 1990, 92] (a) Hydrogen bonding in ethanol (a) Water (b) Ammonia (b) Hydrogen bonding in dimethyl ether (c) Hydrogen fluoride (d) Acetic acid  $CH_3$  group in ethanol (c) The high boiling point of ethanol  $(78.2^{\circ} C)$  compared to dimethyl 26. (d)  $CH_3$  group in dimethyl ether ether (-23.6° C), though both having the same molecular formulae Which of the following hydrogen bonds are strongest in vapour 36. [MP PMT 1993]  $C_6 H_6 O$  , is due to phase [AMU 1999] (a) Hydrogen bonding (a) HF - - - HF(b) HF – – – HCl lonic bonding (h) (c) HCl - - - HCl(d) HF - - - HICoordinate covalent bonding (c) 37. Which of the following shows hydrogen bonding (d) Resonance [CPMT 2000] 27. Methanol and ethanol are miscible in water due to (a)  $NH_3$ (b) *P* [CPMT 1989] Covalent character (a) (d) *Sb* (c) *As* (b) Hydrogen bonding character 38. The boiling point of a compound is raised by [DPMT 2001] (c) Oxygen bonding character (a) Intramolecular hydrogen bonding (d) None of these (b) Intermolecular hydrogen bonding B.P. of  $H_2O(100^{\circ}C)$  and  $H_2S(-42^{\circ}C)$  explained by Covalent bonding 28. (c) lonic covalent (d) (a) Vander Waal's forces (b) Covalent bond The boiling point of water is exceptionally high because 39. (c) Hydrogen bond (d) lonic bond [KCET 2001] 29. Strength of hydrogen bond is intermediate between Water molecule is linear (a) [DPMT 1991] Vander Waal and covalent  $(\mathbf{b})$ Water molecule is not linear (a) lonic and covalent There is covalent bond between *H* and *O* (h) (c)lonic and metallic (d) Water molecules associate due to hydrogen bonding (c) (d) Metallic and covalent  $NH_3$  has a much higher boiling point than  $PH_3$  because 30. In which of the following compounds intramolecular hydrogen bond [UPSEAT 2002; MNR 1994] is present [MP PET 1994] NH 3 has a larger molecular weight (a) (a) Ethyl alcohol (b) Water Salicylaldehyde (d) Hydrogen sulphide (c) NH 3 undergoes umbrella inversion (b) Hydrogen bonding is formed in compounds containing hydrogen 31. NH<sub>3</sub> forms hydrogen bond (c) [MP PET 1995] and (a) Highly electronegative atoms (d)  $NH_3$  contains ionic bonds whereas  $PH_3$  contains covalent Highly electropositive atoms (b) bonds Metal atoms with *d*-orbitals occupied (c) 41. Which one has the highest boiling point [MP PET 2002] (d) Metalloids (a) Acetone (b) Ethyl alcohol Which of the following compounds in liquid state does not have 32. (c) Diethyl ether (d) Chloroform hydrogen bonding [MP PMT 1996] Which of the following compounds has the highest boiling point 42. (a)  $H_2O$ (b)HF (a) HCl (b) HBr (c)  $NH_3$ (d)  $C_6H_6$ (c)  $H_2SO_4$ (d)  $HNO_3$ Compounds showing hydrogen bonding among HF,  $NH_3$ ,  $H_2S$ 33. Which of the following has minimum melting point 43. [UPSEAT 2003] and  $PH_3$  are (a) CsF (b) *HCl* (a) Only HF,  $NH_3$  and  $PH_3$ (d) LiF (c) HF (b) Only HF and  $NH_3$ Hydrogen bond energy is equal to [UPSEAT 2003] 44 (c) Only  $NH_3$ ,  $H_2S$  and  $PH_3$ (a) 3 - 7 cals (b) 30 - 70 cals (d) All the four (d) 30 - 70 kcals (c) 3 - 10 kcals The high density of water compared to ice is due to 34.  $H_2O$  is a liquid while  $H_2S$  is gas due to [BHU 2003] 45. [CBSE PMT 1997; BHU 1999; AFMC 2001] (a) Covalent bonding (a) Hydrogen bonding interactions (b) Molecular attraction (b) Dipole-dipole interactions H – bonding (c) Dipole-induced dipole interactions (c) Induced dipole-induced dipole interactions H – bonding and molecular attraction (d)

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46 $H$ - bonding is maximum in[BVL 2023](a) C- $_{A}H_{a}OH$ (b) C- $_{a}H_{a}COOH$ (c) C- $_{A}H_{a}OH$ (	UNIT	VERSAL SCORER 124 Chemical Bonding					
(a) $C_gH_1OH$ (b) $C_gH_1COOH$ (c) $CI_1C_1C_1OH$ (d) $CH_1COCH_1$ (e) $CI_1C_1C_1OH$ (d) $CH_1COCH_1$ (e) $CCC_1C_1$ (d) $CH_1OH$ (e) $CCC_1C_1$ (d) $CH_1OH$ (e) $CCCT_1OH$ (d) $CH_1OH$ (f) $CHCR_1$ (d) $CH_1OH$ (g) $CCCT_1OH$ (d) $CH_1OH$ (f) $CHCR_1OH$ (f) $CHT_1OH$ (g) $CCCT_1OH$ (f) $CHT_1OH$ (h) $Helphy direct = 100 H$ (f) $CHT_1OH$ (h) $Helphy direct = 100 H$ (f) $CHT_1OH$ (f) $Helphy direct = 100 H$ (f) $Helphy direct = 100 H$ (f) $Helphy direct = 100 H$ (f) $Hel$	46.	<i>H</i> – bonding is maximum in	[BHU 2003]		(a) Overlapping valency of	orbitals	
C $G L_3 G L_2 G M$ C $G L_3 G L_2 G M$ C $G L_3 G L_3 G M$ C $G M G M M$ 48.When to be cobes are presedow over each etch. they unit to form one cube. Which of the following force is responsible for holding them sequet () Worker Waals forces 		(a) $C_6 H_5 OH$ (b)	b) $C_6H_5COOH$		(b) Mobile valency electro	ons	
(a)(b)(c)(		$(c)  CH_{-}CH_{-}OH \qquad (a)$	(H,COCH)		(c) Delocalized electrons		
47.Select the compound runn the balaxong which masses in waterControlControCont				Q	(d) Highly directed bonds	s of colid	
(a)CC/L(b)CS 2(c)CHCl 3(d)C_2H_2OH(e)48.Whet two ice cubes are presented for haking then together(e)Fe(f)(f)Vander Wals forces(f)(F)(f)(g)Vander Wals forces(f)(F)(f)(h)Vander Wals forces(f)(F)(f)(h)Vander Wals forces(f)(F)(f)(h)Vander Wals forces(f)(F)(f)(h)Vander Wals forces(f)(f)(f)(h)Content transition(f)(f)(f)(h)Content transition(f)(f)(f)(h)Content transition(f)(f)(f)(h)Note(f)(f)(f)(h)Note(f)(f)(f)(h)Note(f)(f)(f)(h)Note(f)(f)(f)(h)Note(f)(f)(f)(h)Note(f)(f)(f)(h)Note(f)(f)(f)(h)Note(f)(f)(f)(h)Note(f)(f)(f)(h)Note(f)(f)(f)(h)Note(f)(f)(f)(h)Note(f)(f)(f)(h)Note(f)(f)(f)(h)Note(f)(f)(f)(h)Note(f) <td>47.</td> <td>Select the compound from the follow</td> <td>wing which dissolves in water</td> <td>0.</td> <td>(a) Remains unchanged</td> <td>(b) Ch</td> <td>anges</td>	47.	Select the compound from the follow	wing which dissolves in water	0.	(a) Remains unchanged	(b) Ch	anges
(c) $CHCl_j$ (c) $C_2I_1OH$ 9.Which of the following has the highest methody point (CMT 1994)48.When two is caubes are pressed over each other, they unit to form one cube. Which of the following force is responsible for holding (c) $Pb$ (b)Damond(c)Varier(b)Pb(c) $Aa$ (c)(d)Dipole-dipole attraction (d)(c) $Fc$ (c) $Aa$ (e)Constant attractive and (d)(c) $Fc$ (c) $Aa$ (e)Constant attractive and (d)(c) $Fc$ (c) $Aa$ (e)In the formation of a molecule by an atom(APMC 1992)(a)In the formation of a molecule by an atom(APMC 1992)(a)In the formation of a molecule by an atom(APMC 1992)(a)In the formation of a molecule by an atom(APMC 1992)(a)In the following there does forces operate (e)(c)(c)(f)Which is the weakest memory the following there does forces operate (e)(d)(f)More of the following atom(f)(g)Water(h)(f)(g)Water(h)(h)Water(h)(h)Water(h)(h)Water(h)(h)Water(h)(h)Water(h)(h)Water(h)(h)Water(h)(h)Water(h)(h)Water(h)(h)Water(h)(		(a) $CCl_4$ (b)	$CS_2$		(c) Becomes compact	(d) No	ne of the above
43. When two is clubs are presed over ach other, they unit to form one cube. Which of the following force is responsible for holding them together       [CPMT 994]         (a) Vander Waal's forces       [NCERT 9978]         (b) Hydrogen hond formation       (c) Covalent attraction         (c) Covalent attraction       [NCERT 9978]         (a) Dipole-dipole attraction       [NCERT 9978]         (b) Hydrogen hond formation       [NCERT 9978]         (c) Covalent attraction       [NCERT 9978]         (d) Dipole-dipole attraction       [NCERT 9978]         (e) Mond is not present in       [NCERT 9978]         (f) Hydrogen hond (d) Hydrogen bond       [NCERT 9978]         (g) Mond is not present in       [NCERT 9978]         (h) Hydrogen functide       (d) Hydrogen Sulphide         Types of bonding and Forces in solid       [NCERT 9984]         (e) Nuclear forces       (d) Covalent bond         (c) Nuclear forces       (d) Covalent bond         (e) Nuclear forces       (f) When one is the highest mething haldse         (f) Nuclear forces       (f) When one is the highest mething haldse         (g) Nuclear forces       (h) Waterney of mobile decross         (h) Hydrogen bonds       (h) Hydrogen bonds         (c) Nache forces       (h) Wheren the following the thores         (h) Nacher forces		(c) CHCl <sub>3</sub> (c	d) $C_2H_5OH$	9.	Which of the following has	the highest me	lting point
(a) Vunder Waals forces (b) Hydrogen bond formation (c) Covalent attraction (d) Dipole-dipole attraction(a) Vunder Waals forces (b) Hydrogen bond (c) Covalent bond (d) Hydrogen bond (e) Multich is the weakest among the following types of bond (f) Multich bond (c) Covalent bond (f) Multich bond (f) Multich bond (f) Which is the weakest attractive forces operate (f) None of these (f) None of these (h) Near (h) Multich bond (f) None of these (f) None of these (f) None of these (f) None of these (f) None of these (h) Near (h) Multich bond (c) Auter (f) Nucker forces (f) Nucker forces (h) Silver (f) Nucker forces (h) Silver (f) Nucker forces (h) Nucker forces (h) Silver (h) Nucker forces (h) Silver (h) Nucker forces (h) Multich site heighest melting halde (h) Multich forces (h) Nucker forces for oblick forces (h) Multich site heighest melting halde (h) Multich forces (h) Multich force force force for oblick forces (h) Multich force force force for oblick forces (h) Multich forces (h) Multich forces (h) Multich weaked for other following subtances consists of small discrete (h) Nucker for the following subtances consists of small discrete (h) Nucker for the following dees not apply to mutallich forc	48.	When two ice cubes are pressed ov one cube. Which of the following them together	rer each other, they unit to form force is responsible for holding		(a) $Pb$	(b) Dia	[CPMT 1994]
(a) Functional operation (b)(b) Hydrogen box (c) <td></td> <td>(a) Vander Waal's forces</td> <td></td> <td>10</td> <td>(c) <i>F e</i></td> <td>(d) IV</td> <td></td>		(a) Vander Waal's forces		10	(c) <i>F e</i>	(d) IV	
(c)Covalent attraction(d)Dipole-dipole attraction(d)Dipole-dipole attraction(d)Dipole-dipole attraction(e)Covalent attraction(f)UNCERT 1979; MADT Blar 1984](a)Ionic bond(b)Metallic bond(c)Covalent bond(d)Hydrogen bland(e)Covalent bond(f)Hydrogen Blaoride(g)Hydrogen Blaoride(g)Hydrogen SulphideTypes of bonding and Forces in solid(h)Hercine(h)Electrons(h)Electrons(h)Electrons(h)Electrons(h)Electrons(h)Electrons(h)Electrons(h)Electrons(h)Electrons(h)Electrons(h)Electrons(h)Electrons(h)Electrons(h)Electrons(h)Electrons(h)Electrons(h)Electrons(h)Electrons(h)Electrons(h)Metallic bond(h)Electrons(h)Electrons(h)Electrons(h)Mall(h)Electrons(h)Mall(h)Electrons(h)Mall(h)Electrons(h)Mall(h)Electrons(h)Mall(h)Electrons		(b) Hydrogen bond formation		10.	(a) Attractive forces oper	ate	[/////01993]
(a) Dipole-dipole attraction (b) Divide has weakest band (c) Covalent bond (c) Explosive (c) Covalent bonds (c) Covalent bond at the same time (c) Covalent bond at the same time (c) Covalent bond is present in the following which metals is due to (covalent indece ordinate bond is present in the following (c) Nucker firence (c) Covalent bond is present in the following (c) Nucker firences in energy (c) Nucker inference in energy (		(c) Covalent attraction			(b) Repulsive forces operation	ate	
(d) None of these(BMMT 1997)(a) Ionic bond(b) Mctallic bond(c) Covalent bond(b) Mctallic bond(c) Covalent bond(d) Hydrogen bond(e) KCRT 1979, MANT Blar 1984)(f) Diamond(h) Neon (Solid)(a) Water(b) Mctallic bond(c) KCA(d) Lee(a) Water(b) Gycerol(c) KCA(d) H_C(a) Water(b) Gycerol(c) KCA(d) H_C(c) Hydrogen fluoride(d) Hydrogen Sulphide(d) Hard(e) KCA <b>Types of bonding and Forces in solid</b> (e) KCA(f) Keerol(f) Electrons(h) Electrostatic forces(g) WH1 (g) FNT 2005(a) Copper(b) Silver(c) Canc(d) Marcury(a) Ionic bonds(h) Hydrogen bonds(c) Yander Kable Sole(f) Nice to the following the weakest one is(g) Electrons(h) Electrostatic forces(JP FNT 2005)(a) Copper(b) Silver(c) Zinc(d) Marcury(a) In besidiargen, the atoms are held together by(f) Marcury(a) In the following torse atoms(h) Hydrogen bonds(c) Vander Waals forces(JP FNT 2005)(a) Ionic bonds(h) Hydrogen bonds(c) NaCl(b) NaBr(c) NaCl(b) NaBr(c) NaCl(c) AnaCl(c) NaCl(b) NaBr(c) NaCl(b) NaBr(c) NaCl(c) CT(d) NaCl(b) NaBr(e) NaCl(b) NaBr(f) The ecknowled findinge of valuery dectrons(h) The ecknowled findinge of valuery dectrons(h) The ecknowled findinge of valu		(d) Dipole-dipole attraction			(c) Both attractive and re	pulsive forces o	perate
INCRT 1997; MADT Bits 1984](a) tonic bond(b) Metallic bond(c) Cavalent bond(d) Hydrogen bond(a) Water(b) Glycerol(c) KCC 2005](a) Water(b) Glycerol(a) Water(b) Glycerol(c) Hydrogen fluoride(d) Hydrogen Sulphide(a) $He^{-1}$ Types of bonding and Forces in solid(b) Electrons (c) Naclear forces(b) Electrostatic forces(c) Naclear forces(b) Electrostatic forces(c) Naclear forces(d) Oxalent bonds(c) Naclear forces(d) Covalent bonds(EMCET 1982)(a) Copper(b) Silver(c) Carl A force(d) Varceus(a) In the following metals which one has lowest probable inferatorie forces(MP PT 1995)(a) lonic bonds(b) Hydrogen bonds(c) Vander Waals force(d) Macu(c) Nacle forces(d) Macu(f) Nacl(c) Nacle forces(d) Macu(f) Nacl(c) Nacle forces(d) Macu(f) Nacl(c) Nacl C(f) Nall(f) Nacl(c) Nacl C(g) NaBr(g) Carl (h) Macu(a) Macu(h) Hydrogen bonds(c) Nacl C(g) NaBr(g) Carl (h) Macu(h) The content metals balle(AUMS 1980)(a) The content integes between atoms(c) CT(c) The lack of exchange of valency electrons (d) The exchange energy of mobile electrons (d) The exchange energy of mobile electrons (d) The exchange energy of mobile electrons (f) The lack of echange of valency electrons (d) The echange energy of mobile electrons (d) The echange of valency electrons (d) The e	40	Which is the weakest among the fol	lowing types of bond		(d) None of these		
(a) tonic bond(b) Metallic bond(c) Karl (b) Metallic bond(a) Water(b) Glycerol(c) KAC(d) the(a) Water(b) Glycerol(c) KAC(d) H_2Q(c) Hydrogen fluoride(d) Hydrogen Sulphide(a) $He$ (b) HCl(c) Hydrogen fluoride(d) Hydrogen Sulphide(a) $He$ (b) HCl(c) Hydrogen fluoride(d) Hydrogen Sulphide(a) $He$ (b) HCl(c) Hydrogen fluoride(d) Hydrogen Sulphide(d) $H_2Q$ (c) Expers of bonding and Forces in Solid(e) Expersive (c) Explosive(f) Viscous(a) Electrons(b) Electrostatic forces(d) Covalent bonds(e) Explosive(c) Nuclear forces(d) Covalent bonds(b) Silver(c) Zine(d) Macrury(a) Ionic bonds(b) Hydrogen bonds(b) Silver(b) CsCl > NaCl > KCl > RbCl > CsCl(c) Vander Waals forces(d) Hydrogen bonds(b) NaBr(c) Cl <sup>-</sup> (d) $H_2Q$ (a) Inic bonds(b) Hydrogen bonds(f) Nal(f) Nal(f) The electrovalent inlages between atoms(f) Nal(c) NaF(d) NalNaBr(f) Nal(f) Nal(f) Nal(f) Nal(f) Nal(f) The electrovalent inlages between atoms(f) The formation of a chemical bond is accompanied by(f) The	-17	when to the weakest among the for	[NCERT 1979: MADT Bihar 1984]	11.	Which has weakest bond		[RPMT 1997]
(c)Covalent bond(d)Hydrogen bond(e)(e)(d)fee50.#Abord is not present in(BCECE 2005)(a)Which of the following exhibits the weakest intermolecular forces [AW(a)Water(b)GECEE 2005](c)He(b)HCI(c)Hydrogen fluoride(d)Hydrogen Sulphide(e)(f)He(f)HeTypes of bonding and Forces in solid(e)He(f)(f)(f)(f)(f)(a)In a crystal cations and anions are held together by(f)(f)Neet(f)(f)Neet(f)(f)Neet(f)(f)Neet(f)Nactive(f)Nactive(f)(f)Nactive(f)Nactive(f)(f)Nactive(f)(f)Nactive(f)(f)Nactive(f)(f)Nactive(f)		(a) Ionic bond (i	<ul> <li>Metallic bond</li> </ul>		(a) Diamond	(b) Ne	on (Solid)
DefinitionConstraint of the point of the control of the		(c) Covalent bond (c	d) Hydrogen bond	10	(c) $KCl$	d) lce): ا	
(a) Water(b) Glycerol(c) Trice(c) Hydrogen fluoride(d) Hydrogen SulphideTypes of bonding and Forces in Solid(c) Hydrogen fluoride(d) Hydrogen SulphideTypes of bonding and Forces in Solid(c) KP5_3(d) $H_2O$ (a) Electrons(b) Electrostatic forces(c) Nuclear forces(d) Covalent bonds(e) Zine(d) Mercury(a) Inic bonds(b) Silver(c) Zine(d) Mercury(a) Inic bonds(b) Hydrogen bonds(c) Vander Waals forces(d) Mercury(a) Inic bonds(b) Hydrogen bonds(c) Vander Waals forces(d) MaCl > LICl > NaCl > RbCl > LICl(c) Vander Waals forces(d) Hydrogen bonds(c) NaF(d) NaCl(c) NaF(d) NaBr(c) NaF(d) NaBr(c) NaF(d) NaBr(c) NaF(d) NaBr(c) NaF(d) NaCH(b) The elack of exclaine of this following substances consists of small discrete (c) The covalent linkages between atoms (c) The elack of exclaine of following substances consists of small discrete (CART 1997) (a) Mich of the following substances consists of small discrete (c) Copper(f) Dry ice7. Which of the following substances consists of small discrete (c) Copper(f) Dry ice7. Which of the following does not apply to metallic bond (c) Copper(f) Dry ice7. Which of the following does not apply to metallic bond (c) Co	50.	<i>H</i> -bond is not present in	[BCECE 2005]	12.	(a) Ha	(L) U	ci
(c)Hydrogen fluoride(d)Hydrogen SulphideTypes of bonding and Forces in solid1In a crystal cations and anions are held together by [EMCET 1982]13(e) $Ractive(c)1.In a crystal cations and anions are held together by(c)Nuclear forces(d)Covalent bonds(e)Nuclear forces(d)Covalent bonds2.In the following metals which one has lowest probable interatomicforces(b)Silver(d)Amerury(d)Merury3.In solid argon, the atoms are held together by(c)Zinc(d)Merury(d)NaCI(b)NaBr(c)(d)Marcury(d)NaCI(d)Merury3.In solid argon, the atoms are held together by(c)NaCI(b)NaBr(c)NaCI(d)$	-	(a) Water (ł	o) Glycerol		(a) He	(b) II (J) II	
Types of bonding and Forces in solid[PET 200]1.In a crystal cations and anions are held together by[PAMCET 1982](a)Electrons(b)Electrostatic forces(c)Explosive(d)Viscous(a)Electrons(b)Electrostatic forces(d)Covalent bonds(e)Vander Waal's force(d)Covalent bond(a)Copper(b)Silver(c)Van der Waal's force(d)Covalent bondLattice energy of alkali metal chlorides follows the order(a)Copper(b)Silver(c)LiCl > NaCl > KCl > RbCl > CsCl(b)Covalent bond(c)Zinc(d)Mercury(d)NaCl > LiCl > KCl > RbCl > CsCl(d)Lattice energy of alkali metal chlorides follows the order(a)Insolid argon, the atoms are held together by[DPMT 2004](d)NaCl > LiCl > KCl > RbCl > CsCl(d)(a)Insolid argon, the atoms are held together by[NCERT 1972](d)NaCl > LiCl > KCl > RbCl > CsCl(a)Inte covalent linkages between atoms[NCERT 1972](e)Cl <sup>-1</sup> (d) $H_2O_2$ (a)The covalent linkages between atoms[CPMT 1997](a)CH4(b)KCl(b)The covalent linkages between atoms[CPMT 1997](a)CH4(b)KCl(c)The covalent linkages between atoms[CPMT 1997](a)CH4(b)KCl(c)The covalent linkages between atoms[CPMT 1997](a)CH4(b) <td></td> <td>(c) Hydrogen fluoride (d</td> <td>d) Hydrogen Sulphide</td> <td>10</td> <td>(c) <math>NH_3</math></td> <td>(а) <i>п</i> -1111</td> <td>20 </td>		(c) Hydrogen fluoride (d	d) Hydrogen Sulphide	10	(c) $NH_3$	(а) <i>п</i> -1111	20 
Types of bonding and Forces in solid1.In a crystal cations and anions are held together by [EMMCET 1982](a) Sweet (b) Reactive (c) Explosive (d) Viscous(a) Electrons (b) Electrostatic forces (c) Nuclear forces (d) Covalent bonds(b) Electrostatic forces (d) Covalent bonds2.In the following metals which one has lowest probable interatomic forces (d) Mercury(a) Metallic bond (b) Ionic bond (c) Van der Waal's force (d) Covalent bond3.In solid argon, the atoms are held together by (e) Zinc (d) Mercury(a) Mercury (MP MT 1995]3.In solid argon, the atoms are held together by (c) Vander Waals forces (d) Hydrophobic forces(b) KCI > KCI > RbCI > LiCl (C) LiCl > CCI > RaCI > KCI > RbCI > LiCl (C) LiCl > CCI > RaCI > KCI > RbCI > LiCl (C) LiCl > CCI > RaCI > CCI4.Which one is the highest melting halide (c) NaF (c) NaF(a) NaCI (b) NaBr (c) The eaker force of cohesion in metals is due to (MR 1986; MP PMT 2004]5.The enhanced force of cohesion in metals is due to (c) The leck of exchange of valency electrons (c) The leck of exchange of valency electrons 			, , , , , , , , , , , , , , , , , , , ,	13.	Glycerol has strong interm	olecular bonding	g therefore it is
I.In a crystal cations and anions are held together by [EMCET 1982](c)Exp(CET 1982)(a)Electrons(b)Electrostatic forces(c)Nuclear forces(d)Covalent bonds(c)Nuclear forces(d)Covalent bonds(e)Viscous(a)In the following metals which one has lowest probable interatomic forces(a)Metallic bond(c)Viscous(a)Copper(b)Silver(c)Viscous(d)Mercury(e)(c)Zinc(d)Mercury(e)Lattice energy of alkali metal chlorides follows the order(c)Zinc(d)Mercury(e)Lattice energy of alkali metal chlorides follows the order(b)Silver(e)Lattice onergy of alkali metal chlorides follows the order(c)Zinc(d)Mercury(e)(a)Insidi argon, the atoms are held together by(f)CSCl > NaCl > KCl > RbCl > CSCl(a)Ionic bonds(b)Hydrogrhobic forces(a)NaCl(b)NaBr(c)(c)NaF(d)NaBr(e)(c)NaF(d)NaI17.(a)The enhanced force of cohesion in metals is due to molecules[CPMT 1987](b)The enhanced force of cohesion sit of small discrete molecules[CPMT 1987](c)The enhance of the following substances consists of small discrete molecules[CPMT 1987](c)MaCl(b)Graphitie (c)(c)(c)<	_	Types of bonding and	Forces in solid		(a) Sweet	(b) Rea	active
1.       In a crystal cations and amons are held together by       IA.         I. In the following metals which one has lowest probable interatomic forces       (a) Covalent bonds         2.       In the following metals which one has lowest probable interatomic forces       (b) Electrostatic forces         (a) Copper       (b) Silver       (c) Zinc         (c) Zinc       (d) Mercury         3.       In solid argon, the atoms are held together by       (c) LiCl > NaCl > KCl > RbCl > CsCl         (a) Ionic bonds       (b) Hydrogen bonds       (c) LiCl > NaCl > KCl > RbCl > CsCl         (a) Ionic bonds       (b) Hydrogen bonds       (c) LiCl > KCl > RbCl > CsCl         (c) Vander Waals forces       (d) Hydrogrobic forces       (a) MCL (b) NaBr         (c) NaF       (d) NaCl       [AllMS 1980]         (a) NaCl       (b) NaBr       (c) Cl <sup>2</sup> (a) The covalent linkages between atoms       (c) SO2       (d) MaCl         (e) The lack of excharge of valency electrons       [MRR 1996; MP PT 1992]         (a) MaCl       (b) Graphite       (CPMT 1987;         (c) Copper       (d) Dry ice       (a) Decrease in energy         (b) The electrovalent linkages between atoms       (CPMT 1987;         (c) Copper       (d) Dry ice       (a) Decrease in energy         (b) The electrovalent linka	_		111 1		(c) Explosive	(d) Vis	cous
[PK.PKT 2004; CMT 2002](a) Electrons(b) Electrostatic forces(a) Metallic bond(b) Ionic bond(c) Nuclear forces(d) Covalent bond(e) Van der Waal's force(f) Covalent bond(a) Copper(b) Silver(c) Zinc(d) Mercury(a) $LiCl > NaCl > RbCl > RbCl > LiCl(c) Zinc(d) Mercury(a) Ionic bonds(b) Hydrogen bonds(c) LiCl > CsCl > NaCl > RbCl > RbCl > LiCl(a) Ionic bonds(b) Hydrogen bonds(c) Vander Waals forces(d) NaCl > LiCl > CsCl(d) NaCl > LiCl > CsCl(a) Ionic bonds(b) Hydrogen bonds(f) In the following which molestane time(d) NaCl > LiCl > CsCl(d) NaCl > LiCl > CsCl(a) NaCl(b) NaBr(c) NaF(c) Cl > Cale + RbCl > CsCl(d) NaCl > LiCl > CsCl(a) NaCl(b) NaBr(c) Cl > Cl > Cl > NaCl > RbCl > RbCl > CsCl(d) NaCl > LiCl > CsCl(a) NaCl(b) NaBr(c) Cl > Cl > Cl > Cl > NaCl > RbCl > CsCl(d) NaCl > LiCl > CsCl > NaCl > RbCl > CsCl(a) NaCl(b) NaBr(c) Cl > Cl > Cl > Cl > Cl > NaCl > RbCl > CsCl(d) NaCl > LiCl > CsCl > NaCl > RbCl > CsCl(a) NaCl(b) NaBr(c) Cl > Cl > Cl > Cl > (d) H_2O_2(a) The exclange of valency electrons(c) CI > Cl > Cl > Cl > (d) MaOH(d) The exchange of valency electrons(c) SO_2(d) NaOH(d) The exchange of the following substances consists of small discrete molecules(d) None of the following does not apply to metallic bond(a) NaCl(b) Graphite(c) Copper(d) Dry ice(a) NaCl(b) Graphite(c) Copper$	Ι.	In a crystal cations and anions are n		14.	Among the following the w	reakest one is	
(a)Deterrors(b)Electronic (c)(c)Nuclear forces(c)Covalent bonds(c)Nuclear forces(d)Covalent bonds(a)Copper(b)Silver(c)(c)Zinc(d)Mercury(a)In the following metals which one has lowest probable inferatomic (c)Zinc(d)(e)Zinc(d)Mercury(a)(a)Ionic bonds(b)Hydrogen bonds(c)(a)Ionic bonds(b)Hydrogen bonds(c)(c)Vander Waals forces(d)Hydrogen bonds(e)(c)Vander Waals forces(d)Hydrogen bonds(e)(a)NaCl(b)NaBr(c)Cl (c)(a)NaCl(b)NaBr(c)Cl (c)(c)NaF(d)NaI17.(a)The enhanced force of cohesion in metals is due to[MNR 1980](a)The covalent linkages between atoms(c)SO 2(d)The exchange or ray of mobile electrons(c)SO 2(d)The schange or ray of mobile electrons(c)SO 2(d)NaCl(b)Graphite(c)(e)Copper(d)Dry ice(a)NaCl(b)Graphite(c)Copper(d)Dry ice(d)NaCl(c)Nacl(e)Copper(d)Dry ice(f)Which one of the following does not apply to metallic bond(		() <b>E</b>			()	(1) 1	[Pb. PMT 2004; CPMT 2002]
(c) Nuclear forces(d) Covalent bonds(d) Covalent bonds2. In the following metals which one has lowest probable interatomic forces[MP PMT 1690](a) Copper(b) Silver[DPMT 2004](c) Zinc(d) Mercury(a) Insolid argon, the atoms are held together by[DCERT 198]; MP PET 1995](a) Ionic bonds(b) Hydrogen bonds(c) LiCl > CsCl > NaCl > KCl > RbCl > CsCl(a) Ionic bonds(b) Hydrogen bonds(c) Vander Waals forces(d) NaCl > LiCl > KCl > RbCl > CsCl(a) Ionic bonds(b) Hydrogen bonds(c) LiCl > CsCl > NaCl > KCl > RbCl > CsCl(a) Ionic bonds(b) Hydrogen bonds(c) LiCl > CsCl > NaCl > KCl > RbCl > CsCl(a) NaCl(b) NaBr(c) Cl <sup>-</sup> (c) NaF(d) Nal17.(a) The covalent linkages between atoms[NCERT 1972](a) The covalent linkages between atoms[CPMT 1987](b) The electrovalent linkages between atoms[CPMT 1987](c) The lack of exchange of valency electrons[CPMT 1987](a) NaCl(b) Graphite(c) Copper(d) Dry ice(a) NaCl(b) Graphite(c) Copper(d) Dry ice(f) Which of the following does not apply to metallic bond(g) Rep Part 1986][Chemical bond implies(g) Copper(d) Nore of these(h) Hour does of the following does not apply to metallic bond(h) Hour do		(a) Electrons (t	b) Electrostatic forces		(a) Metallic Dond	(b) Ion (d) Co	ic Dond
2.In the following metals which one has lowest probable interatorine forces[MP PMT 1990](a) Copper (c) Zinc(d) Mercury(a) LiCl > NaCl > KCl > RbCl > LiCl3.In solid argon, the atoms are held together by[NCERT 198; MP PET 1995](a) Ionic bonds(b) Hydrogen bonds(c) Vander Waals forces(c) Vander Waals forces(d) Hydrophobic forces4.Which one is the highest melting halide[AIIMS 1980](a) NaCl(b) NaBr(c) Cl <sup>-</sup> (c) NaF(d) Nal5.The enhanced force of cohesion in metals is due to[MCERT 1972](a) The covalent linkages between atoms(c) Cl <sup>-</sup> (d) The exchange of valency electrons[CPMT 1987](a) NaCl(b) Graphite(c) Copper(d) Dry ice(a) NaCl(b) Graphite(c) Copper(d) Dry ice(c) Copper(d) Dry ice(c) Copper(d) Dry ice(d) NaCl(b) Graphite(c) Copper(d) Dry ice(c) Copper(d) Dry ice	_	(c) Nuclear forces (c	d) Covalent bonds	15.	Lattice energy of alkali me	tal chlorides fol	lows the order
(a) Copper (b) Silver (c) Silver (c) Silver (c) Zinc (c) Marcine	2.	In the following metals which one forces	has lowest probable interatomic [MP PMT 1990]		(a) $LiCl > NaCl > KC$	1 > RbCl > C	[DPMT 2004]
(c) Zhe(a) Mercury(b) Mercury(c) Each Filter Filter3. In solid argon, the atoms are held together by $[NCERT 198; MP PET 1995]$ (c) $LiCl > CsCl > NaCl > KCl > RbCl(a) Ionic bonds(b) Hydrogen bonds(c) Vander Waals forces(d) Hydrophobic forces4. Which one is the highest melting halide[AIIMS 1980](a) HCl(b) NH_4^+(a) NaCl(b) NaBr(c) Cl^-(d) H_2O_2(c) NaF(d) NaI17.Both ionic and covalent bond is present in the following5. The enhanced force of cohesion in metals is due to[NCERT 1972](a) CH_4(b) KCl(a) The covalent linkages between atoms(c) SO_2(d) NaOHThe formation of a chemical bond is accompanied by(d) The exchange energy of mobile electrons[MP PET 1995](a) NaCl(b) Graphite(c) CPMT 1987](a) NaCl(b) Graphite(c) Copper(c) Copper(d) Dry ice(d) None of these7. Which of the following does not apply to metallic bond[CREF PMT 1980](b) Increase in energy(d) None of these$					(b) $C_sC_l > N_aC_l > K_l$	T > RhC > L	iCl
3.       In solid argon, the atoms are near together by       INCERT 198; MP PET 1995]         (a) tonic bonds       (b) Hydrogen bonds         (c) Vander Waals forces       (d) Hydrophobic forces         4.       Which one is the highest melting halide       [AIIMS 1980]         (a) $NaCl$ (b) $NaBr$ (c) $NaF$ (d) $NaI$ 5.       The enhanced force of cohesion in metals is due to         (a) The covalent linkages between atoms       [NCERT 1972]         (a) The covalent linkages between atoms       [NCERT 1972]         (a) The covalent linkages between atoms       [NCERT 1972]         (a) The exchange of valency electrons       [MP PET 1995]         (d) The exchange energy of mobile electrons       [MP PET 1987]         (a) NaCl       (b) Graphite         (c) Copper       (d) Dry ice         7.       Which of the following does not apply to metallic bond         (c) Copper       (d) Dry ice         7.       Which of the following does not apply to metallic bond         (c) Copper       (d) Dry ice         7.       Which of the following does not apply to metallic bond         (c) Copper       (d) Dry ice         7.       Which of the following does not apply to metallic bond         (c) Copper       (d) D	~	(c) Zilic (c)	a) Mercury		(c) $LiCl > CsCl > Nat$	Cl > KCl > Rl	
(a) lonic bonds(b) Hydrogen bonds(c) Vander Waals forces(d) Hydrophobic forces4.Which one is the highest melting halide[AIIMS 1980](a) $MaCl$ (b) $NaBr$ (c) $Cl^-$ (d) $H_2O_2$ (a) $NaCl$ (b) $NaBr$ (c) $Cl^-$ (d) $H_2O_2$ (d) $H_2O_2$ (d) $H_2O_2$ (c) $NaF$ (d) $NaI$ 17.Both ionic and covalent bond is present in the following5.The enhanced force of cohesion in metals is due to[MNR 1986; MP PMT 2004](a) The covalent linkages between atoms(c) The lack of exchange of valency electrons(d) $NaCl$ (e) The lack of exchange of valency electrons(e) $SO_2$ (d) $NaOH$ 6.Which one of the following substances consists of small discrete molecules[CPMT 1987](a) $NaCl$ (b) Graphite(c) Neither increase in energy(c) Copper(d) Dry ice(e) Neither increase nor decrease in energy(d) None of the following does not apply to metallic bond[CESE PMT 1080](f) Which of the following does not apply to metallic bond[See PMT 1080](c) Copper(d) Dry ice[See PMT 1080](c) See PMT 1080](c) Chemical bond implies	3.	in solid argon, the atoms are neid to	[NCEPT 1091 MD DET 1007]		(d)  NaCl > LiCl > KC	V > RbCl > Co	s Cl
(a) holic bolts (b) Hydroghobic forces (c) Vander Waals forces (d) Hydrophobic forces (d) Hydrophobic forces (e) Vander Waals forces (d) Hydrophobic forces (a) $NaCl$ (b) $NaBr$ (c) $Cl^-$ (d) $H_2O_2$ (c) $NaF$ (d) $NaI$ (e) $NaF$ (d) $NaI$ (for the enhanced force of cohesion in metals is due to [NCERT 1972] (a) The covalent linkages between atoms (c) The lack of exchange of valency electrons (d) The exchange energy of mobile electrons (d) The exchange energy of mobile electrons (a) $NaCl$ (b) Graphite (c) Copper (d) Dry ice 7. Which of the following does not apply to metallic bond [NCERT 1972] (a) $NaCl$ (b) Graphite (c) Copper (d) Dry ice 7. Which of the following does not apply to metallic bond [NCERT 1972] (a) $NaCl$ (b) Graphite (c) Copper (d) Dry ice 7. Which of the following does not apply to metallic bond [NCERT 1972] (a) $NaCl$ (b) Graphite (c) Copper (d) Dry ice 7. Which of the following does not apply to metallic bond [NCERT 1972] (a) $NaCl$ (b) Graphite (c) Copper (d) Dry ice 7. Which of the following does not apply to metallic bond [NCERT 1972] (a) $NaCl$ (b) Graphite (c) Copper (d) Dry ice 7. Which of the following does not apply to metallic bond [NCERT 1972] (a) $NaCl$ (b) Graphite (c) Copper (d) Dry ice 7. Which of the following does not apply to metallic bond [NCERT 1978] (C) Chemical bond implies [NCERT 1978]		(a) lonic bonds (1	Hydrogen bonds	16.	In the following which	molecule or io	n possesses electrovalent.
(c) Valuet Waas forces(d) Figure Mode forces4.Which one is the highest melting halide[AIIMS 1980](a) $HCl$ (b) $NH_4^+$ (a) $NaCl$ (b) $NaBr$ (c) $Cl^-$ (d) $H_2O_2$ (c) $NaF$ (d) $NaI$ 17.Both ionic and covalent bond is present in the following5.The enhanced force of cohesion in metals is due to[MCERT 1972](a) $CH_4$ (b) $KCl$ (a) The covalent linkages between atoms(c) The lack of exchange of valency electrons(a) $CH_4$ (b) $KCl$ (b) The electrovalent linkages between atoms(c) $SO_2$ (d) $NaOH$ (formation of a chemical bond is accompanied by(d) The exchange energy of mobile electrons[CPMT 1987](a) $NaCl$ (b) Graphite(c) Neither increase in energy(a) $NaCl$ (b) Graphite(c) Sopper(d) $Dry$ ice(c) Neither increase nor decrease in energy(d) None of these7.Which of the following does not apply to metallic bondIf CRE PMT 1980]19.Chemical bond implies[KCET 2002]		(a) Vander Waals forces	d) Hydrophobic forces		covalent and co-ordinate b	ond at the same	time
4.Winch one is the inglese intering name $[Pining rigot]$ $(D - L + L)$ (a) $NaCl$ (b) $NaBr$ (c) $Cl^-$ (d) $H_2O_2$ (c) $NaF$ (d) $NaI$ 17.Both ionic and covalent bond is present in the following5.The enhanced force of cohesion in metals is due to[MNR 1986; MP PMT 2004](a) The covalent linkages between atoms[NCERT 1972](a) The covalent linkages between atoms(c) $SO_2$ (c) The lack of exchange of valency electrons(a) The exchange energy of mobile electrons(c) The lack of exchange of valency electrons18.(d) The exchange energy of mobile electrons[CPMT 1987](a) $NaCl$ (b) Graphite(c) Copper(d) Dry ice7.Which of the following does not apply to metallic bond(CREE PMT 1980][9.(d) None of these19.Chemical bond implies	4	Which one is the highest melting ha	lide [A11MS 1080]		(a) HCl	(b) <i>N</i> .	$H_4^+$
(a) <i>Nucl</i> (b) <i>NaI</i> (c) $Cl$ (d) $H_2O_2$ (c) <i>NaF</i> (d) <i>NaI</i> 17.Both ionic and covalent bond is present in the following5.The enhanced force of cohesion in metals is due to[MNR 1986; MP PMT 2004](a)The covalent linkages between atoms[NCERT 1972](a)The covalent linkages between atoms(c)(b)The electrovalent linkages between atoms(c)(c)The lack of exchange of valency electrons(a)(d)The exchange energy of mobile electrons(c)6.Which one of the following substances consists of small discrete molecules[CPMT 1987](a) <i>NaCl</i> (b)Graphite (c)(c)(c)Copper(d)Dry ice7.Which of the following does not apply to metallic bond19.Chemical bond implies[KCET 2002]	4.	(a) $NaCl$	NaBr		$() Cl^{-}$	(1) 11	
(c)NaP(d)NaP17.Both ionic and covalent bond is present in the following5.The enhanced force of cohesion in metals is due to[MNR 1986; MP PMT 2004](a)The covalent linkages between atoms[NCERT 1972](a)The electrovalent linkages between atoms(c)(c)The lack of exchange of valency electrons(c)(d)The exchange energy of mobile electrons(c)(d)The exchange energy of mobile electrons(c)(d)NaCl(c)(a)NaCl(c)(a)NaCl(b)(c)Copper(d)(d)Dry ice7.Which of the following does not apply to metallic bond[CRSE PMT 1080](c)Mark to the following does not apply to metallic bond[KCET 2002]			N N L		(c) <i>Cl</i>	(d) H	202
5.       The enhanced force of conston in metals is due to       [MNR 1986; MP PMT 2004] $[NCERT 1972]$ (a) $CH_4$ (b) $KCl$ (a) The covalent linkages between atoms       (c) $SO_2$ (d) $NaOH$ (c) The lack of exchange of valency electrons       (a) The exchange energy of mobile electrons       (c) $SO_2$ (d) $NaOH$ (d) The exchange energy of mobile electrons       (c) $SO_2$ (d) $NaOH$ (d) Naccl       (c) MP PET 1995]       (a) Decrease in energy         (a) NaCl       (b) Graphite       (c) Neither increase nor decrease in energy         (d) None of the following does not apply to metallic bond       (c) Neither increase nor decrease in energy         (d) None of these       (ferse PMT 1980)       (gerse PMT 1980)	-	(c) $NaF$		17.	Both ionic and covalent bo	nd is present in	the following
(a) The covalent linkages between atoms(a) $CH_4$ (b) $KCl$ (b) The electrovalent linkages between atoms(c) The lack of exchange of valency electrons(c) $SO_2$ (d) $NaOH$ (d) The exchange energy of mobile electrons18.The formation of a chemical bond is accompanied by(d) The exchange energy of mobile electrons18.The formation of a chemical bond is accompanied by(a) NaCl(b) Graphite(c) Copper(d) Dry ice(a) NaCl(b) Graphite(c) Neither increase nor decrease in energy(d) None of the following does not apply to metallic bond19.Chemical bond implies(fCRSE PMT 1980)19.Chemical bond implies[KCET 2002]	5.	The enhanced force of conesion in r	INCERT 1972				[MNR 1986; MP PMT 2004]
<ul> <li>(b) The electrovalent linkages between atoms</li> <li>(c) The lack of exchange of valency electrons</li> <li>(d) The exchange energy of mobile electrons</li> <li>(d) The exchange energy of mobile electrons</li> <li>(e) The following substances consists of small discrete molecules</li> <li>(for seven in the following does not apply to metallic bond</li> <li>(c) SO<sub>2</sub></li> <li>(d) NaOH</li> <li>(e) SO<sub>2</sub></li> <li>(for seven in the following substances consists of small discrete molecules</li> <li>(for seven in the following does not apply to metallic bond</li> <li>(c) SO<sub>2</sub></li> <li>(d) NaOH</li> <li>(e) SO<sub>2</sub></li> <li>(for seven in the following substances consists of small discrete molecules</li> <li>(for seven in the following does not apply to metallic bond</li> <li>(for seven in the following does not apply to metallic bond</li> <li>(for seven in the following does not apply to metallic bond</li> <li>(for seven in the following does not apply to metallic bond</li> <li>(for seven in the following does not apply to metallic bond</li> <li>(for seven in the following does not apply to metallic bond</li> <li>(for seven in the following does not apply to metallic bond</li> <li>(for seven in the following does not apply to metallic bond</li> <li>(for seven in the following does not apply to metallic bond</li> <li>(for seven in the following does not apply to metallic bond</li> <li>(for seven in the following does not apply to metallic bond</li> <li>(for seven in the following does not apply to metallic bond</li> <li>(for seven in the following does not apply to metallic bond</li> <li>(for seven in the following does not apply to metallic bond</li> <li>(for seven in the following does not apply to metallic bond</li> <li>(for seven in the following does not apply to metallic bond</li> <li>(for seven in the following does not apply to metallic bond</li> <li>(for seven in the following does not apply to metallic bond</li> <li>(for seven in the following does not apply to metallic bond</li> <li>(for seven in th</li></ul>		(a) The covalent linkages between	atoms		(a) $CH_4$	(b) <i>K</i>	Cl
<ul> <li>(c) The lack of exchange of valency electrons</li> <li>(d) The exchange energy of mobile electrons</li> <li>6. Which one of the following substances consists of small discrete molecules [CPMT 1987]</li> <li>(a) NaCl</li> <li>(b) Graphite</li> <li>(c) Copper</li> <li>(d) Dry ice</li> <li>7. Which of the following does not apply to metallic bond</li> <li>18. The formation of a chemical bond is accompanied by [MP PET 1995]</li> <li>(a) NaCl</li> <li>(b) Graphite</li> <li>(c) Copper</li> <li>(d) Dry ice</li> <li>(c) Neither increase nor decrease in energy</li> <li>(d) None of these</li> <li>19. Chemical bond implies [KCET 2002]</li> </ul>		(b) The electrovalent linkages betw	veen atoms		(c) <i>SO</i> <sub>2</sub>	(d) <i>N</i>	аOH
<ul> <li>(d) The exchange energy of mobile electrons</li> <li>6. Which one of the following substances consists of small discrete molecules [CPMT 1987]</li> <li>(a) NaCl</li> <li>(b) Graphite</li> <li>(c) Copper</li> <li>(d) Dry ice</li> <li>(d) None of these</li> </ul> 7. Which of the following does not apply to metallic bond (a) for the following does not apply to metallic bond (b) Increase in energy <ul> <li>(c) Copper</li> <li>(d) Dry ice</li> <li>(d) None of these</li> </ul> (c) Chemical bond implies [KCET 2002]		(c) The lack of exchange of valency	y electrons	18.	The formation of a chemic	al bond is accon	npanied by
<ul> <li>6. Which one of the following substances consists of small discrete molecules [CPMT 1987]</li> <li>(a) NaCl</li> <li>(b) Graphite</li> <li>(c) Copper</li> <li>(d) Dry ice</li> <li>(d) Dry ice</li> <li>(e) Neither increase nor decrease in energy</li> <li>(d) None of these</li> <li>7. Which of the following does not apply to metallic bond</li> <li>19. Chemical bond implies</li> <li>[KCET 2002]</li> </ul>		(d) The exchange energy of mobile	electrons				[MP PET 1995]
(a) NaCl       (b) Graphite       (c) Copper       (d) Dry ice       (c) Neither increase nor decrease in energy         7. Which of the following does not apply to metallic bond       19.       Chemical bond implies       [KCET 2002]	6.	Which one of the following subst	ances consists of small discrete		(a) Decrease in energy		
<ul> <li>(a) recer (b) Graphice (c) Neither increase nor decrease in energy (c) Copper (d) Dry ice (d) None of these</li> <li>7. Which of the following does not apply to metallic bond [CBSE PMT 1080]</li> <li>19. Chemical bond implies [KCET 2002]</li> </ul>		(a) $Na(1)$ (1)	[CrMI 1987]		(b) Increase in energy		
<ul> <li>7. Which of the following does not apply to metallic bond</li> <li>[CRSE PMT 1980]</li> <li>19. Chemical bond implies</li> <li>[KCET 2002]</li> </ul>		(c) Copper (c	d) Drv ice		(c) Neither increase nor o	lecrease in ener	gy
[CRSE PMT 1080] 19. Chemical bond implies [KCET 2002]	7.	Which of the following does not app	bly to metallic bond		(d) None of these		
			[CBSE PMT 1989]	19.	Chemical bond implies		[KCET 2002]

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				Chemical Bonding 125
	(a) Attraction			[UPSEAT 200
	(b) Repulsion		(a) $N_2 H_5^+$	(b) $BaCl_2$
	(c) Neither attraction nor repulsion			
	(d) Both (a) and (b)		(c) <i>HC1</i>	(d) $H_2O$
20.	Which of the following statements is true [AIEEE 2002]	6.	Which combination	is best explained by the co-ordinate covaler
	(a) <i>HF</i> is less polar than <i>HBr</i>		bond JIPMER 2001; CE	
	(b) Absolutely pure water does not contain any ions		(a) $H^+ + H_2 O$	(b) $CI + CI$
	(c) Chemical bond formation take place when forces of attraction		$() M_{\alpha} + \frac{1}{2} O$	
	(d) In covalency transference of electron takes place		(c) $Mg + \frac{1}{2}O_2$	(d) $H_2 + I_2$
01	(d) in contactory transience of electron takes place Which of the following statements is true about $\begin{bmatrix} C_{1}(NH_{1}) \end{bmatrix}$ SO	7.	Arrange the follow	ing compounds in order of increasing dipol
21.	which of the following statements is the about $[Cu(101_3)_4]OO_4$		moment.	
	(a) It has coordinate and covalent bonds		(1) Toluene	(11) $m$ – dichlorobenzene
	(b) It has only coordinate bonds		(III) <i>o</i> – dichlorobe	nzene (IV) $p$ – dichlorobenzene
	(d) It has electrovalent conclust and scondingts hands			[11T 1996
22	(d) It has electrovalent, covalent and coordinate bonds		(a) $I < IV < II <$	III (b) $IV < I < II < III$
22.	(a) Jonic hand (b) Coordinate hand		(c) $IV < I < III <$	$II \qquad (d)  IV < II < I < III$
	(c) Hydrogen bond (d) All the above	8.	The correct order of	dipole moment is [Roorkee 1999]
22	The number of ionic covalent and coordinate houds in NH Cl		(a) $CH_4 < NF_3$	$< NH_3 < H_2O$
20.	are respectively [MP PMT 1999]		(b) $NF_3 < CH_4 <$	$NH_3 < H_2O$
	(a) 1. 3 and 1 (b) 1. 3 and 2		(c) NH $< NE$	< CH < H O
	(c) 1, 2 and 3 (d) 1, 1 and 3			$\langle c n_4 \rangle \langle n_2 o$
24.	Covalent molecules are usually held in a crystal structure by		(d) $H_2 O < NH_3$	$< NF_3 < CH_4$
	[MP PET 1995]	9.	Which of the followi	ng has the highest dipole moment
	(a) Dipole-dipole attraction	()		AIIMS 2002
	(b) Electrostatic attraction	$\sim$		
	(c) Hydrogen bonds		(a) $H \swarrow C = O$	(b) $C = C$
	(d) Vander Waal's attraction			CH <sub>3</sub> H
			$CH_3 H$	$Cl$ $CH_3$
	C Critical Thinking		(c) $C = C$	(d) $\stackrel{ }{C} = \stackrel{ }{C}$
			$CH_{3}H$	$CH_{2}$ $Cl$
=	Objective Questions	10.	Which of the follow	ing arrangement of molecules is correct on th
			basis of their dipole	moments [AllMS 2002]
1.	The values of electronegativity of atoms $A$ and $B$ are 1.20 and 4.0		(a) $BF_3 > NF_3 >$	$NH_3$ (b) $NF_3 > BF_3 > NH_3$
	respectively. The percentage of fonic character of $A = B$ bond is		(c) $NH_3 > BF_3$	$> NF_3$ (d) $NH_3 > NF_3 > BF_3$
	(a) $50\%$ (b) $43\%$	n.	The type of hybrid o	rbitals used by the chlorine atom in $ClO_2^-$ is
	(u) 72.2470		(a) $sp^3$	(b) $sp^2$
2.	$O_2^{2-}$ is the symbol of ion [EAMCET 2003]		(c) $sp$	(d) None of these
	(a) Oxide (b) Superoxide	12.	Among the follow	ing species, identify the isostructural pair
	(c) Peroxide (d) Monoxide		$NF_3$ , $NO_3^-$ , $BF_3$ ,	$H_3O^+, HN_3$ [11T 1996
3.	The number of electrons that are paired in oxygen molecule is		(a) $[NF_3, NO_3^-]$	and $[BF_2, H_2O^+]$
	(a) 7 (b) 8		(b) [NE HN]	$and [NO^{-} BE]$
	(c) 14 (d) 16		(b) $[1VT_3, 11V_3]$	
4.	When $N_2$ goes to $N_2^+$ , the $N-N$ bond distance and when		(c) $[NF_3, H_3O^+]$	] and $[NO_3^-, BF_3^-]$
	$0 = 0$ and $0^+$ the $0 = 0$ hand distance		(d) $[NF_3, H_3O^+]$	] and $[HN_3, BF_3]$
	G <sub>2</sub> goes to G <sub>2</sub> , the G = G bond distance	13.	In the compound $C$	$H_2 = CH - CH_2 - CH_2 - C \equiv CH$ , the
			$C_2 - C_3$ bond is of	the type [IIT 1999
	(a) Decrease, increase (b) increase, decrease		() 2	(1)3 3
F	Which of the following contains a coordinate and there is		(a) $sp - sp^-$	(b) $sp^2 - sp^2$
э.	when of the following contains a coordinate covalent bolid			

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#### 126 Chemical Bonding (d) Isoelectronic and weak field ligands (d) $sp^2 - sp^3$ $sp - sp^3$ (c)The number of S - S bonds in sulphur trioxide trimer $S_3 O_0$ is 24 The correct order of increasing C - O bond length of 14. (a) Three $CO, CO_3^{2-}, CO_2$ is [IIT 1999] (c) One Strongest intermolecular hydrogen bond is present in the following 25. (a) $CO_3^{2-} < CO_2 < CO$ (b) $CO_2 < CO_3^{2-} < CO$ (d) $CO < CO_2 < CO_3^{2-1}$ (c) $CO < CO_3^{2-} < CO_2$ 15. In the dichromate dianion [IIT 199 (a) 4 Cr - O bonds are equivalent 6 Cr - O bonds are equivalent (b) (c) All Cr - O bonds are equivalent (d) All Cr - O bonds are non-equivalent Bond length of ethane (1), ethene (11), acetylene (111) and benzer 16. (IV) follows the order [CPMT 199 (a) I > II > III > IV(b) I > II > IV > III(c) I > IV > II > III(d) III > IV > II > IHybridisation state of chlorine in $ClF_3$ is [RPET 199 17. (a) $sp^3$ (b) $sp^3d$ (c) $sp^3d^2$ (d) $sp^3d^3$ Molecular shapes of $SF_4$ , $CF_4$ and $XeF_4$ are 18. [IIT Screening 200 (a) The same with 2, 0 and 1 lone pairs of electrons respectively (b) The same, with 1, 1 and 1 lone pairs of electrons respectively (c) Different, with 0, 1 and 2 lone pairs of electrons respectively (d) Different, with 1, 0 and 2 lone pairs of electrons respectively Structure of $IF_4^+$ and hybridization of iodine in this structure are 19. (a) $sp^3d$ , Linear (b) $sp^3d^2$ , *T*-shaped (c) $sp^3d$ , Irregular tetrahedral (d) $sp^3d^2$ , Octahedral In which of the following the central atom does not use sp hybr 20. orbitals in its bonding [UPSEAT 2001, 0 (b) $OH_{3}^{+}$ (a) $BeF_3^-$ (d) *NF*<sub>3</sub> (c) $NH_{2}^{-}$ 21. The magnetic moment of $K_3[Fe(CN)_6]$ is found to be 1.7 B./ How many unpaired electron (s) is/are present per molecule (a) 1 (b) 2 (a) (d) 4 (c) 3 22. $N_2$ and $O_2$ are converted into monocations $N_2^+$ and $O_2^+$ *(b)* respectively. Which is wrong [CBSE PMT 1997] (a) In $N_2$ , the N - N bond weakens (c) (d) (b) In $O_2$ , the Q - Q bond order increases (e) (c) In $O_2$ , paramagnetism decreases 1. Assertion : (d) $N_2^+$ becomes diamagnetic

- The common features among the species  $CN^-$ , CO and  $NO^+$  are [IIT Screening 2001]
  - (a) Bond order three and isoelectronic
  - (b) Bond order three and weak field ligands
  - (c) Bond order two and  $\pi$ -acceptors

23.

(a) $SiH_4$ and $SiF$ O $\parallel$ (b) $CH_3 - C - CH_3$ and O $\parallel$	CHCl <sub>3</sub>
(b) $CH_3 - C - CH_3$ and O	CHCl <sub>3</sub>
(b) $CH_3 - C - CH_3$ and O	CHCl <sub>3</sub>
<i>O</i>	-0
11	
(c) $H - C - OH$ and $CH$	$I_3 - C - OH$
(d) $H_2O$ and $H_2O_2$	<b>&gt;</b>
A compound contains atom	s X, Y, Z. The oxidation number o
X is +2, $Y$ is +5 and $Z$	is $-2$ . Therefore, a possible formula
of the compound is	[CPMT 1988]
(a) XYZ <sub>2</sub>	(b) $X_2 (YZ_3)_2$
(c) $X_3 \left( Y Z_4 \right)_2$	(d) $X_3 \left(Y_4 Z\right)_2$
Bonds present in $CuSO_4.5$	<i>H</i> <sub>2</sub> <i>O</i> is [11T 1983; DCE 2001
(a) Electrovalent and covale	ent
(b) Electrovalent and coord	inate
(c) Electrovalent, covalent a	nd coordinate
(d) Covalent and coordinate	2
The ionization of hydrogen a	tom would give rise to
	[UPSEAT 2001
(a) Hybrid ion	(b) Hydronium ion
(c) Proton	(d) Hydroxyl ion
Which can be described a capacity	as a molecule with residual bonding [JIPMER 2000
(a) $BeCl_2$	(b) NaCl
(c) $CH_4$	(d) $N_2$
	(d) $H_2O$ and $H_2O_2$ A compound contains atom X is +2, $Y$ is +5 and $Zof the compound is(a) XYZ_2(c) X_3(YZ_4)_2Bonds present in CuSO_4.5(a) Electrovalent and covale(b) Electrovalent and coord(c) Electrovalent, covalent a(d) Covalent and coordinateThe ionization of hydrogen a(a) Hybrid ion(c) ProtonWhich can be described acapacity(a) BeCl_2(c) CH_4$

(b) Two

(d) Zero

- If both assertion and reason are true and the reason is the correct explanation of the assertion.
- If both assertion and reason are true but reason is not the correct explanation of the assertion.
- If assertion is true but reason is false.
- If the assertion and reason both are false.
- If assertion is false but reason is true.
  - Water is a good solvent for ionic compounds but poor one for covalent compounds.
    - Reason Hydration energy of ions releases sufficient energy to overcome lattice energy and break hydrogen bonds in water, while covalent bonded compounds interact so weakly that even Vander

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							Cnem		ing 127	SE	LF SCORER
			Wall's forces between molecules of covalentcompounds cannot be broken.[AIIMS 1996]	16.	Assertion	:	The crystal the sum of	l structure get f electron gain	s stabilize enthalpy	d ever and i	n though onizatior
2.	Assertion	:	The atoms in a covalent molecule are said to share electrons, yet some covalent molecules are polar.		Reason	:	Energy is crystal latti	absorbed du ice.	ring the	form	ation of
	Reason	:	In a polar covalent molecule, the shared electrons spend more time on the average near one of the	17.	Assertion	:	Order of 1 LiX > Na	lattice energy $\mu X > KX$ .	for same	halide	es are as
2	Assartion		atoms. [AIIMS 1996]		Reason	:	Size of alkato $K$ .	aline – earth r	netal incre	eases	from <i>Li</i>
з.	Rescon	•	There are no enough valence electrons to form	18.	Assertion	:	Born-Haber	cycle is based o	n Hess's la	w.	
		·	the expected number of covalent bonds[AIIMS 2001]		Reason	:	Lattice en Haber cycl	thalpy can b	e calcula	ted ł	oy Born
4.	Assertion	:	A resonance hybrid is always more stable than any of its canonical structures	19.	Assertion	:	Bond	energy 1	has	order	like
	Reason	:	This stability is due to delocalization of electrons[Al	IMS 1999]			C-C < C	$C = C < C \equiv 0$	С.		
5.	Assertion	:	All $F - S - F$ angle in $SF_4$ greater than 90° but less than 180°		Reason	:	Bond ener order.	gy increases	with incr	ease	in bond
	Reason	:	The lone pair-bond pair repulsion is weaker than bond pair-bond pair repulsion	20.	Assertion	:	Electron a attraction	ffinity refers for an add	to an is litional e	solated lectro	d atom's n while
			[AllMS 2004]				electronega	tivity is the a	itself in a	an ele	ement to
			0			$\mathbf{\Lambda}$	electrons.		itsen in a	51141 0	
6.	Assertion	:	The electronic structure of $O_3$ is $O = O$		Reason		Electron a electronega	affinity is a itivity is experi	relative mentally r	num neasu	ber and rable.
	Passan		structure is not allowed because	21.	Assertion		Geometry	of $SF_4$ mole	ecule can	be te	ermed as
	Reason	÷	$\begin{array}{c} 0 \\ 0 \\ \end{array}$		$\sim$		distorted to	etrahedron. a f	olded sau	are or	see saw.
			octet around cannot be expanded. [ <b>11T 1998</b> ]		Reason	:	Four fluori sulphur ma	ne atoms surro plecule.	ound or fo	orm b	ond with
7.	Assertion	:	Bond order can assume any value number	22.	Assertion	:	$BF_2$ has g	reater dipole	moment tl	han I	$H_{2}S$ .
			including zero		Reason	•	Fluorine is	more electron	egative th	an cul	nhur
	Reason	:	Higher the bond order, shorter is bond length and greater is bond energy	23.	Assertion	:	The bond	between two i	dentical n	onmet	tal atoms
8.	Assertion	:	[AIIMS 1999] Ortho nitrophenol molecules are associated due to the		Reason	:	Electrons a	ire transferred	fully from	n one	atom to
			presence of intermolecular hydrogen bonding while paranitrophenol involves intramolecular, hydrogen	24.	Assertion	:	<i>B</i> molecule	e is diamagneti	c.		
	Reason	:	bonding Ortho nitrophenol is more volatile than the para		Reason	:	The highes type.	st occupied m	olecular c	orbital [ <b>Al</b> l	is of <i>C</i> IMS 2005
9.	Assertion		Nitrogen molecule diamagnetic.	25.	Assertion	:	The nearl orbitals abo	y tetrahedral out the oxygen	arrange atom allo	ment ws ea	of the ach water
-	Reason	:	$N_2$ molecule have unpaired electrons.				molecule t	o form hydrog	en bonds	with	as many
10.	Assertion	:	Ice is less dense than liquid water.				as four neg	ghbouring wat	er molecu	les.	1 1
	Reason	:	There are vacant spaces between hydrogen bonded water molecules in ice		Keason	:	In ice each as each mo	lecule is fixed	in the spa	ydrog ice.	en bonds
11.	Assertion	:	Water is liquid but $H_2S$ is a gas.	26.	Assertion	:	The bond of The second	order of heliun	n is always	s zero.	11
	Reason	:	Oxygen is paramagnetic.		Reason	:	orbital an	d antibonding	s in Done v molecu	lar o	noieculai orbital is
12.	Assertion	:	lodine is more soluble in water then in carbon tetrachloride.				equal.				
	Reason	:	lodine is a polar compound.								
13.	Assertion	:	o and $p$ -nitrophenols can be separated by			-/1	ne	MOR	Ċ		
			steam distillation.		4		112		3		
	Reason	:	o -nitrophenol have intramolecular hydrogen bonding while $p$ -nitrophenol exists as								
			associated molecules.			Ele	ectrovale	ent bondi	ng		
14.	Assertion	÷	The fluorine has lower reactivity.	4	h 0		2			E	
	Reason		F-F bond has low bond dissociation energy.	1	b 2	a	3	a 4	C	5	C
15.	Assertion	:	$\sigma$ is strong while $\pi$ is a weak bond.	6	d 7	d	8	b 9	С	10	d
	Reason	:	Atoms rotate freely about $\pi$ bond.	11	b 1	2 a	13	d 14	a	15	a
				16	c 1	7 h	19	a 10	d	20	•

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UNIVERSAL SLF SCORER 128 Chemical Bonding

21	b	22	d	23	а	24	a	25	b
26	d	27	d	28	C	29	а	30	d
31	b	32	b	33	b	34	d	35	b
36	а	37	b	38	а	39	а	40	С
41	C	42	b	43	d	44	b	45	С
46	C	47	а	48	b	49	C	50	b
51	b	52	b	53	а	54	а	55	а
56	C	57	а	58	C	59	а	60	C
61	а	62	b	63	d	64	d	65	b
66	a	67	abc	68	bd				

## **Covalent bonding**

1	C	2	C	3	В	4	b	5	d
6	а	7	C	8	a	9	d	10	a
11	b	12	b	13	С	14	b	15	С
16	а	17	a	18	C	19	а	20	b
21	а	22	а	23	C	24	С	25	C
26	C	27	а	28	а	29	а	30	d
31	b	32	a	33	d	34	а	35	d
36	b	37	d	38	C	39	d	40	С
41	b	42	b	43	b	44	b	45	b
46	d	47	d	48	b	49	а	50	a
51	b	52	d	53	C	54	d	55	d
56	d	57	a	58	a	59	d	60	a
61	c	62	а	63	b	64	b	65	b
66	b	67	b	68	d	69	b	70	C
71	c	72	C	73	cd	74	ad	75	ab
76	а								

## **Co-ordinate or Dative bonding**

1	d	2	b	3	C	4	d	5	C		
6	b	7	а	8	d	9	а	10	d		
11	C	12	а	13	а	14	b	15	c		

Dinole moment

_													
1	b	2	d	3	d	4	а	5	C				
6	C	7	а	8	а	9	С	10	b				
11	b	12	d	13	b	14	С	15	d				
16	C	17	C	18	а	19	С	20	b				
21	d	22	b	23	b	24	b	25	а				
26	b	27	b	28	b	29	С	30	а				
31	a	32	C	33	a	34	bd	35	а				

# Polarisation and Fajan's rule d 2 c 3 b 4 d 5 a 7 b 8 a 0 a 10

6	а	7	b	8	а	9	С	10	b
11	d	12	C	13	b	14	b	15	d
16	d	17	c	18	b	19	а	20	d
21	а	22	C	23	d	24	а	25	b
26	b								
					_	_			

## Overlaping - $\sigma$ and $\pi$ - bonds

1	С	2	C	3	b	4	b	5	С				
6	С	7	C	8	b	9	d	10	C				
11	b	12	С	13	а	14	а	15	d	Ī			
16	а	17	d	18	C	19	d	20	d				

## Hybridisation

1	d	2	d	3	d	4	C	5	d
6	а	7	c	8	b	9	d	10	d
11	d	12	а	13	а	14	b	15	а
16	b	17	C	18	а	19	d	20	b
21	c	22	c	23	а	24	c	25	а
26	а	27	b	28	С	29	b	30	а
31	d	32	а	33	d	34	C	35	C
36	b	37	b	38	c	39	b	40	b
41	d	42	b	43	С	44	а	45	C
46	c	47	d	48	b	49	c	50	a
51	b	52	а	53	c	54	c	55	C
56	d	57	b	58	а	59	b	60	C
61	b	62	c	63	b	64	b	65	b
66	а	67	C	68	b	69	C	70	а
71	a	72	а	73	b	74	b	75	d
76	d	77	c	78	а	79	d	80	b
81	C	82	b	83	d	84	а	85	d
86	b	87	d	88	C	89	а	90	С
91	C	92	c	93	а	94	b	95	С
96	a	97	b	98	b	99	b	100	b
101	a	102	b	103	d	104	а	105	b
106	а	107	а	108	b	109	b	110	a
111	а	112	b	113	b	114	d	115	d
116	С	117	с	118	b	119	с	120	а
121	а	122	c	123	а	124	а	125	b
126	C	127	d	128	C	129	C	130	а
131	b	132	b	133	е	134	C	135	d

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136	b	137	b	138	d	139	a	140	a
141	а	142	b	143	а	144	а	145	а
146	b	147	C	148	d	149	bcd	150	а
151	ac	152	a						

	Resuldice												
1	d	2	b	3	b	4	b	5	b				
		_		-									
6	С	7	а	8	С	9	b	10	С				
11	abcd												

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## **VSEPR** Theory

1	а	2	а	3	b	4	C	5	С
6	b	7	b	8	С	9	b	10	а
11	C	12	а	13	а	14	а	15	С
16	C	17	b	18	d	19	d	20	а
21	a	22	d	23	b	24	d	25	а
26	C	27	b	28	b	29	а	30	а
31	а	32	C	33	C	34	а	35	С
36	b	37	b	38	d	39	d	40	b
41	C	42	а	43	b	44	C	45	d

## Molecular orbital theory

1	а	2	C	3	b	4	b	5	C
6	d	7	C	8	b	9	С	10	b
11	c	12	b	13	С	14	а	15	С
16	C	17	d	18	b	19	С	20	C
21	d	22	C	23	b	24	c	25	a
26	d	27	b	28	b	29	а	30	c
31	C	32	а	33	C	34	а	35	C
36	d	37	b	38	a	39	а	40	c
41	C	42	a	43	b	44	а	45	a
46	c	47	b	48	C	49	C	50	a
51	c	52	b	53	a	54	а	55	a
56	C	57	C	58	C	59	а	60	a
61	a	62	b	63	а	64	C	65	a
66	c	67	a	68	а	69	C	70	a
71	b	72	b	73	d	74	c	75	a
76	b	77	b	78	а	79	С	80	a
81	c	82	а	83	с	84	d		
			Hyd	roge	n bor	nding			
1	d	2	b	3	b	4	а	5	с

6	d	7	b	8	d	9	С	10	C
11	d	12	b	13	а	14	b	15	d
16	d	17	b	18	d	19	С	20	C
21	a	22	а	23	d	24	а	25	c
26	a	27	b	28	С	29	а	30	c
31	а	32	b	33	d	34	а	35	a
36	a	37	а	38	b	39	d	40	c
41	а	42	С	43	b	44	С	45	C
46	b	47	d	48	b	49	d	50	d

## Types of bonding and Forces in solid

1	b	2	d	3	С	4	С	5	d
6	d	7	d	8	b	9	b	10	C
11	d	12	a	13	d	14	С	15	а
16	b	17	d	18	а	19	d	20	c
21	d	22	d	23	а	24	d		
11 16 21	d b d	12 17 22	a d d	13 18 23	d a a	14 19 24	c d d	15 20	a c

## **Critical Thinking Question**

	VI								
1	d	2	C	3	C	4	b	5	а
6	а	7	b	8	a	9	а	10	d
11	а	12	C	13	d	14	d	15	b
16	C	17	b	18	d	19	C	20	а
21	а	22	d	23	a	24	d	25	C
26	С	27	C	28	C	29	а		

## **Assertion & Reason**

1	а	2	а	3	а	4	а	5	С
6	b	7	b	8	е	9	С	10	а
11	b	12	d	13	а	14	е	15	С
16	c	17	c	18	b	19	а	20	c
21	b	22	е	23	d	24	d	25	а
26	а								

# **Chemical Bonding 129**

SELF SC

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#### 24 (a) Answers and Solutions $MSO_4$ . 25. 26. (d) **Electrovalent bonding** (d) 27. hydrated. (b) *NaCl* is ionic crystal so it is formed by $Na^+$ and $Cl^-$ ions. 30. Bond formation is always exothermic. Compounds of sodium (a) are ionic. According to Fajan's rule ionic character is less. (a) (b) 32. Valencies of L, Q, P and R is -2, -1, +1 and +2 respectively so (c) they will form $P_2L$ , RL, PQ and $RQ_2$ . 33. (c) Electrovalent compounds are good conductor of heat and electricity in molten state or in aqueous solution. (d) 34. (d) Electrovalent bond formation depends on ionization energy of 35. (b) cation, electron affinity of anion and on lattice energy. (b) Na 37. is (b) Because CsF is electrovalent compound. (c) *NaCl* is formed by electrovalent bonding. 38. (a) (d) Valency of metal is + 2 by formula MO so its phosphate would (a) be $M_3(PO_4)_2$ because valency of $[PO_4]$ is - 3. 39. 40. (c) Li. Na and K are alkali metals with low ionization energy and (b) one electron in their outermost shell so they will form cation easily. Melting point and boiling point of electrovalent compounds are 41. (c) (a) high due to strong electrostatic force of attraction between the ions 42. (b) The value of lattice energy depends on the charges present on (d) the two ions and distance between them. It shell be high if 43. charges are high and ionic radii are small. Cs is more electropositive. get lower. (a) 44 (b) X loses electron, Y gains it. (a) Formation of NaCl occurs by $Na_{ion}^+$ and $Cl_{ior}^-$ (c) (c) 45 $MgCl_2$ has electrovalent linkage because magnesium is (b) electropositive metal while chlorine is electronegative. 47. (a) Electrovalent compounds generally have high m.pt and high (a) b.pt due to stronger coulombic forces of attractions. 48 (b) Water is a polar solvent so it decreases the interionic attraction (d) in the crystal lattice due to solvation. 50. (b) (b) 51. Element *C* has electronic structure $1s^2$ , $2s^22p^5$ , it requires (c) increases. only one electron to complete its octet and it will form anion 52. (b) so it will form electrovalent bond. be $XCl_2$ . (b) Since the chloride of a metal is $MCl_2$ therefore metal 'M 53. (a) must be divalent *i.e.* $M^{2+}$ . As a result the formula of its 54. phosphate is $M_3(PO_4)_2$ . (a) 55. (a) (d) In $MPO_4$ the oxidation state of M is +3. Hence, the formula 57.

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of nitrate is  $M(NO_3)_3$ . (a) lon is formed by gaining or losing electrons. To form cation 23. electron are lost from the valency shell, so Zn atoms to  $Zn^{++}$ ions there is a decrease in the no. of valency electron.

#### **Chemical Bonding 133**

SELF SCOR

- $M_3(PO_4)_2$  means M is divalent so formula of its sulphate is
- (b) As the molecular formula of chloride of a metal M is  $MCl_3$ , it is trivalent so formula of its carbonate will be  $M_2(CO_3)_3$ .
- Sodium chloride is electrovalent compound so it dissolves in water which is a polar solvent.
- When sodium chloride is dissolved in water, the sodium ion is
- (d) Yet the formula of sulphate of a metal (*M*) is  $M_2(SO_4)_3$ , it is  $M^{3+}$  ion so formula of its phosphate would be  $MPO_4$ .
- Molten sodium chloride conducts electricity due to the presence of free ions.
- (b) The phosphate of a metal has the formula  $MHPO_4$  it means metal is divalent so its chloride would be  $MCl_2$ .
- Cs is highly electropositive while F is highly electronegative so they will form ionic bond.
- highly electropositive while Clhighly electronegative so they will form ionic bond.
- lonic compounds are good conductors of heat and electricity so they are good electrolyte.
- Metal tends to lose electrons due to low ionization energy.
  - As the formula of calcium pyrophosphate is  $Ca_2P_2O_7$  means valency of pyrophosphate radical is - 4 so formula of ferric pyrophosphate is  $Fe_4(P_2O_7)_3$ .
  - M-X bond is a strongest bond so between Na-Cl is a strongest bond.

The solubility order is :

- $BeF_2 > MgF_2 > CaF_2 > SrF_2$  so  $SrF_2$  is least soluble.
- (d) NaF has maximum melting point, melting point decreases of sodium halide with increase in size of halide their bond energy
- Sulphanilic acids have bipolar structure so their melting point is high and insoluble in organic solvents.
- CaCl<sub>2</sub> will have electrovalent bonding because calcium is electropositive metal while chlorine is electronegative so they will combined with electrovalent bond.
- Electrovalent bond is formed by losing electrons from one atom and gaining electron by other atom *i.e.* redox reaction.
- Electrovalent compound are polar in nature because they are formed by ions.
- CsCl has ionic bonding.
- As soon as the electronegativity increases, ionic bond strength
- This X element is a second group element so its chloride will
- When electronegativity difference is from 1.7 to 3.0. This bond is called as ionic bond.
- Ethyl chloride is an organic compound so it will be covalent.
- Lithium oxide and calcium fluoride show ionic characters.
- Generally cation and anion form ionic bond. (a)
- Those atoms which contain +ve and -ve sign are known as ion. 58. (c)
- Generally Br-F contain maximum electronegativity difference 59. (a) compare to other compound.
- 61. Due to greater electronegativity difference. (a)



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UNIVERSAL SELF SCORER 134 Chemical Bonding

**62.** (b) 
$$Co^{3+} = 3d^6 4s^0$$

 $Ni^{4+} = 3d^6 4s^0$  ,

- **64.** (d)  $BaCl_2$  contain higher ionic character.
- **66.** (a) Electrolytes are compound which get dissociated into their ion in water so it contains electrovalent bond.
- **67.** (abc)  $CaH_2$ ,  $BaH_2$ ,  $SrH_2$  are ionic hydride.
- **68.** (bcd) Generally  $MgCl_2$ ,  $SrCl_2$ ,  $BaCl_2$  are ionic compounds so they conduct electricity in fused state.

#### Covalent bonding

- 2. (c) In  $N_2$  molecule each Nitrogen atom contribute  $3e^-$  so total no. of electron's are 6.
- **3.** (b) Non-metals readily form diatomic molecules by sharing of electrons. Element  $M(1s^2 2s^2 2p^5)$  has seven electrons in its valence shell and thus needs one more electron to complete its octet. Therefore, two atoms share one electron each to form a diatomic molecule  $(M_2)$

$$: M . + . M : \rightarrow (: M : M)$$

- $\textbf{5.} \qquad (d) \quad \text{Covalent character depend on the size of cation and anion.}$
- **6.** (a) In graphite all carbon atoms are  $sp^2$ -hybridised and have covalent bond.
- (c) Silica has tendency to form long chain covalent structure such as carbon so it has giant covalent structure.
- 8. (a) All have linear structure.  $O = C = O, Cl - Hg - Cl, HC \equiv CH$

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- (d) Similar atoms form covalent bond.
- 10. (a) Covalent bond forms when electronegativity difference of two atom is equal to 1.7 or less than 1.7
- **11.** (b) Similar atoms form covalent bond.
- 12. (b) Water is a polar solvent while covalent compounds are nonpolar so they usually insoluble in water.
- (c) BCl<sub>3</sub> is electron deficient compound because it has only '6' electrons after forming bond.
- 14. (b) Due to its small size and 2 electrons in *s*-orbital *Be* forms covalent compound.
- **18.** (c)  $H_2O$  will formed by covalent bonding.
- **21.** (a) Two identical atoms are joined with covalent bond so  $H_2$  will be covalent.
- **23.** (c) Element 'X has atomic no. 7 so its electronic configuration will
  - be 2, 5. So its electron dot symbol would be : X.
- **24.** (c) *C-S* will be most covalent. Covalent character depend on the size of cation and anion.
- (c) HCl has ionic character yet it has covalent compound because electronegativity of chlorine is greater than that of hydrogen.
- **26.** (c) Order of polarising power  $Be^{++} > Li^+ > Na^+$ 
  - Hence order of covalent character  $BeCl_2 > LiCl > NaCl$ .

**31.** (b) Valency of phosphorus in  $H_3PO_4$  is supposed if then 3 + x - 8 = 0, x - 5 = 0, x = 5.

**33.** (d)  $(+1) + x + 3(-2) = 0 \Rightarrow 1 + x - 6 = 0 \Rightarrow x = 6 - 1 = 5$ .

- **34.** (a) *HCl* molecule has covalent bond.
- **35.** (d) Electrovalent compounds have high melting point and high boiling point.

(b) Middle length of 
$$H_2 = 74 \ pm$$
  
Length of  $H = \frac{74}{2} = 37 \ pm$ 

Middle length of 
$$Cl_2 = 198\mu$$

Length of  $Cl = \frac{198}{2} = 99 \, pm$ 

Bond length of HCI = Length of H + Length of CI

$$=37 + 99 = 130 \ pm$$

37. (d) Compound has 254 gm of 
$$I_2$$
 means  $\frac{254}{127} = 2$  mole, while  
80 gm  $Q_2$  means  $\frac{80}{127} = 5$  mole so they will form compound

 $I_2O_5$ .

**38.** (c) 
$$NH_4Cl$$
 has covalent as well as ionic bond.

$$\begin{array}{c} H \\ H \\ H \\ H \\ H \end{array} \rightarrow H^{+} Cl$$

- (d) Covalent character increases when we come down a group so  $CaI_2$  will have highest covalent character.
- (b) In water molecule three atom are linked by covalent bond.

Tucture is 
$$H$$
  $H$ 

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(b) 
$$: N \equiv N^+ - \overset{\cdots}{O} : \stackrel{\cdots}{=} \text{ or } N \equiv N \to O.$$

- **44.** (b) The electronic configuration of Na(Z=11) is  $1s^2, 2s^2 2p^6, 3s^1$ . The oxide of Na is  $Na_2O$ .
  - (b) Covalent bond is directional.
- (d) Bond dissociation energy decreases with increase in size. So D is smallest.
- **48.** (b) Molecule X is nitrogen because nitrogen molecule has triple bond. It's configuration will be  $1s^2$ ,  $2s^2 2p^3$ .
- **49.** (a)  $PCl_5$  does not follow octet rule, it has 10 electrons in its valence shell.
- **50.** (a) The compound will be  $A_2B_3$  (By criss cross rule).
- **51.** (b) Each nitrogen share 3 electrons to form triple bond.
- 52. (d) Urea solution does not conduct electricity because it is a covalent compound.
- 54. (d) Due to the small size and higher ionization energy, boron forms covalent compound.
- **58.** (a)  $BF_3$  contain 6 electron so it is lewis acid.
- **59.** (d) Among the given species. The bond dissociation energy of C-O bond is minimum in case of  $CO_3^{2-}$  by which

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C-O bond become more weaker in  $CO_3^{2-}$  or the bond order of  $CO_3^{2-}$  (1.33) is minimum so the bond become weaker.

60. (a) Valency of  $Na_2S_2O_3$  is supposed to be *x*, then 2+2x+(-6)=0, 2x-4=0, x=2.

**61.** (c) 
$$H - O - S - O - O - S - O - H$$
 (Marshall acid)  
 $O = O - S - O - H = O - H = O - H = O - H$ 

- 62. (a) Among the given choice *Al* is least electropositive therefore, the bond between *Al* and *Cl* will be least ionic or most covalent or the difference in electronegativeity of two atom is less than 1.8.
- **63.** (b) Electronic configuration of  ${}_{16}S^{32} = 1s^2, 2s^2, 2p^6, 3s^2, 3p^4$ . In the last orbit it has only 6 electron. So it require 2 electron to complete its octet, therefore it share 2 electron with two hydrogen atom and forms 2 covalent bond with it.
- 64. (b) The acidity of hydrides of VI group elements increase from top to bottom as the bond strength X H decrease from top to bottom

$$H_2O < H_2S < H_2Se < H_2Te$$

- **65.** (b) We know that  $Al^{+3}$  cation is smaller than  $Na^+$  (because of greater nuclear change) According to Fajan's rule, small cation polarise anion upto greater extent. Hence  $Al^{3+}$  polarise  $Cl^-$  ion upto greater extent, therefore  $AlCl_3$  has covalent bond between Al and Cl atoms.
- 66. (b) Sulphur has the second highest catenation property after carbon. Its molecule has eight atom bonded together (*i.e.*  $S_8$ )
- **67.** (b)  $H_2O_2$  has open book structure.

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**69.** (b) The electronic configuration  $_7 N = 1s^2, 2s^2, 2p^3$ 

> It has 5 electrons in valency shell, hence in ammonia molecule it complete its octet by sharing of three electron with three Hatom, therefore it has  $\mathcal{S}$  electrons in its valence shell in ammonia molecule

of

nitrogen

$$\begin{array}{ccc} \vdots & \vdots \\ H \times \cdot N \cdot \times H & \text{or } H - N - H \\ \vdots & H \\ H \end{array}$$

- **71.** (c) Multiple bonds have more bond energy so  $C \equiv N$  will be the strongest.
- (c) Diamond, silicon and quartz molecule bounded by covalent bond.
- **73.** (cd)  $C_2H_4$  and  $N_2$  has multiple bonds.
- 74. (ad) CO has only 6 electrons while PCl<sub>5</sub> has 10 electrons after sharing so both don't follow octet rule.
- **76.** (a) Among these, *NaH* and  $CaH_2$  are ionic hydrides and  $B_2H_6$ and  $NH_3$  are covalent hydrides.

#### Co-ordinate or Dative bonding





- 3. (c)  $NH_3$  has lone pair of electron while  $BF_3$  is electron deficient compound so they form a co-ordinate bond.  $NF_3 \rightarrow BF_3$ 
  - (d)  $HNO_2$  does not have co-ordinate bond. Structure is H - O - N = O.

7. (a) Structure of 
$$N_2O_5$$
 is  $O = N - O - N = O$ .

9. (a) 
$$SO_3^{2-}$$
 has one coordinate bond.  $O - S - O^{-1}$ 

- (d) Co-ordinate bond is a special type of covalent bond which is formed by sharing of electrons between two atoms, where both the electrons of the shared pair are contributed by one atom. Since this type of sharing of electrons exits in  $O_3$ ,  $SO_3$  and  $H_2SO_4$ . Therefore all these contains coordinate bond.
- (a)  $CH_3 N \stackrel{?}{=} C$  contain dative bond.

(a) 
$$H_3PO_4$$
 is orthophosphoric acid.

$$\begin{array}{c} O \\ \uparrow \\ H - O - P - O - H \\ 0 \\ H \end{array}$$

15. (c) Sulphuric acid contain, covalent and co-ordinate bond.

## **Dipole moment**

- (b) CO<sub>2</sub> is a symmetrical molecule so its dipole moment is zero.
- (d) These all have zero dipole moment.
- (d) HF has largest dipole moment because electronegativity difference of both is high so it is highly polar.
- 5. (c) Due to its symmetrical structure.6. (c) Chloroform has 3 chlorine atom a
  - (c) Chloroform has 3 chlorine atom and one hydrogen atom attached to the carbon so it is polarised and it will show dipole moment.
  - (a) The dipole moment of two dipoles inclined at an angle heta is

given by the equation  $\mu = \sqrt{X^2 + Y^2 + 2XY\cos\theta}$ 

 $\cos 90^\circ = 0$ . Since the angle increases from 90 - 180, the value of  $\cos \theta$  becomes more and more – *ve* and hence resultant decreases. Thus, dipole moment is maximum when  $\theta = 90^\circ$ .

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#### NIVERSAL LF SCORER 136 Chemical Bonding

9. (c) Due to distorted tetrahedral geometry  $SF_4$  has permanent dipole moment F

: S F F

- 10. (b)  $CCl_4$  has no net dipole moment because of its regular tetrahedral structure.
- 12. (d) *H-F* is polar due to difference of electronegativity of hydrogen and fluorine so it shows positive dipole moment.
- 14. (c)  $BCl_3$  has zero dipole moment because of its trigonal planar geometry.
- **16.** (c) Dipole moment of  $CH_3OH$  is maximum in it.
- **20.** (b)  $CH_4$  have regular tetrahedron so its dipole moment is zero.
- 22. (b) Ammonia have some dipole moment.

**23.** (b) Charge of 
$$e^- = 1.6 \times 10^{-19}$$

Dipole moment of  $HBr = 1.6 \times 10^{-30}$ 

Inter atomic spacing  $= 1 \text{ Å} = 1 \times 10^{-10} m$ % of ionic character in

## $HBr = \frac{\text{dipolemoment of } HBr \times 100}{\text{interspacing distance} \times q}$

$$=\frac{1.6\times10^{-30}}{1.6\times10^{-19}\times10^{-10}}\times100$$

$$=10^{-30} \times 10^{29} \times 100 = 10^{-1} \times 100 = 0.1 \times 100 = 10\%$$

- (a) Carbon tetrachloride has a zero dipole moment because of its regular tetrahedral structure.
- **27.** (b)  $BF_3$  has zero dipole moment.
- **29.** (c) Given ionic charge  $= 4.8 \times 10^{-10}$  e.s.u. and ionic distance =  $1A^{\circ} = 10^{-8} cm$  we know that dipole moment = ionic charge × ionic distance =  $4.8 \times 10^{-10} \times 10^{-8}$ 
  - $=4.8 \times 10^{-8}$  e.s.u. *per cm* = 4.8 debye.
- 30. (a) Higher is the difference in electronegativity of two covalently bonded atoms, higher is the polarity. In *HCl* there is high difference in the electronegativity of *H* and *Cl* atom so it is a polar compound.
- **31.** (a) Linear molecular has zero dipole moment  $CO_2$  has linear structure so it does not have the dipole moment O = C = O.
- **32.** (c)  $SF_6$  is symmetrical and hence non polar because its net dipole moment is zero.
- **33.** (a) Polarity create due to the difference in electronegativity of both atom in a molecule except  $H_2$  all other molecule have the different atom so they will have the polarity while  $H_2$  will be non polar.
- 34. (bd) cis isomer shows dipole moment while that of trans is zero or very low value. Trans 1, 2 di-chloro-2-pentene will also show dipole moment due to unsymmetry.
- **35.** (a) % of ionic character

Expected value of dipole moment

(d)  $BF_3$  is planar while  $NF_3$  is pyramidal due to the presence of 1. lone pair of electron on nitrogen in  $NF_3$ . (c)  $H_2O$  is a polar molecule due to electronegativity difference of 2. hydrogen and oxygen. 3. (b) When electronegativity difference is more between two joined atoms then covalent bond becomes polar and electron pair forming a bond don't remain in the centre. Hexane has symmetrical structure so does not have polarity. (d) 4. When two identical atoms form a bond, bond is non-polar. 5. (c) According to Fajan's rule, polarisation of anion is influenced by 6. (a) charge and size of cation more is the charge on cation, more is polarisation of anion. 8. (a) When two atoms shares two electrons it is an example of covalent bond. This covalent bond may be polar or may be non-polar depends on the electronegativity difference. In given example formula is AB. So it is polar. (c) HCl is most polar due to high electronegativity of Cl. 9. (b)  $NH_3$  has  $sp^3$  hybridised central atom so it is non planar. 10.

 $=\frac{1.03}{6.12} \times 100 = 16.83\% \approx 17\%$ 

**Polarisation and Fajan's rule** 

- (d) *p*-dichloro benzene have highest melting point.
  - (b)  $NH_4Cl$  has both types of bonds polar and non polar

$$\begin{array}{c} H \\ H - N \\ H \end{array} \xrightarrow{} H H \end{array} \begin{array}{c} + \\ Cl^{-} \\ H \end{array}$$

- 14. (b) Greater the charge of cation more will be its polarising power (according to Fajan's rule).
- (d) All<sub>3</sub> Aluminiumtriiodide shows covalent character. According to Fajan's rule.
- 16. (d) As the size of anion increases, polarity character increases.
- **20.** (d) Due to the electronegativity difference.
- (a) We know that greater the difference in electronegativity of two atoms forming a covalent bond. More is its polar nature. In *HF* there is a much difference in the electronegatives of hydrogen and flourine. Therefore (*HF*) is a polar compound.
- 22. (c) Silicon tetrafloride has a centre of symmetry.
- **23.** (d)  $BF_3$  have zero dipole moment.
- **25.** (b) According to Fajan's rule largest cation and smallest anion form ionic bond.
- 26. (b) Polarity character is due to the difference in electronegativity of two atoms or molecule.

#### Overlaping- $\sigma$ and $\pi$ - bonds

**i.** (c) 
$$H - C \xrightarrow{\pi} C - H$$

**2.** (c) In fluorinte molecule formation p-p orbitals take part in bond formation.

Experiment al value of dipole moment

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**3.** (b)  $\pi$ -bond is formed by lateral overlapping of unhybridised *p*-*p* orbitals.

(b) 
$$Ca \swarrow 1\sigma$$
 and  $2\pi$ 

- 5. (c) In a double bond connecting two atom sharing of 4 electrons take place as in  $H_2C = CH_2$ .
- **6.** (c)  $C \equiv C$  is a multiple bond so it is strongest.
- **9.** (d) As the bond order increases, C-H bond energy also increases so it will be greatest in acetylene because its B.O. is 3. H H

**n.** (b) 
$$H - C \equiv C - \stackrel{\frown}{C} = \stackrel{\frown}{C}$$
  
**16.** (a)  $N \stackrel{\pi}{=} \stackrel{\sigma}{=} \stackrel{N}{N}$ 

18.

(c)

- 17. (d) We know that trisilylamine is  $sp^2$ -hybridized therefore  $p\pi d\pi$  bonding is possible due to the availability of vacant *d*-orbitals with silicon.
  - $\begin{pmatrix} \circ & \circ \\ S \end{pmatrix}$   $\therefore \qquad 2\sigma, 2\pi \text{ bond and one lone pair.}$   $O \qquad : O$
- **19.** (d) : O = S = O: 5 atoms has 12 electrons in its outermost  $\bigcup_{\parallel}^{\parallel} O$ :
  - shell. One  $(S O)\pi$  bond will be  $(p-p) \pi$  bond while two  $(S O)\pi$  bond will be  $(p-d) \pi$  bond.
- **20.** (d) Structure of  $P_4O_{10}$  is



Each phosphorus is attached to 4 oxygen atoms.

#### Hybridisation

1. (d)  $H_2O$  is not linear because oxygen is  $sp^3$  hybridised in  $H_2O$ .

2. (d)  $O_{9}$ H

**4.** (c)  $CO_2$  has sp – hybridization and is linear.

- **Chemical Bonding 137** (d) No. of e pair =  $3 + \frac{1}{2}[3-3] = 0$ 5. No. of e pair = 3 + 0120 В 1209 No. of atom bonded to the central atom = 3In case of 3, 3 geometry is Trigonal planar. (a) In  $sp^3$  –hybridisation each  $sp^3$  hybridised orbital has 1/4 s-6. character. (b) In ethylene both Carbon atoms are  $sp^2$  - hybridised so  $120^o$ . 8. Structure of  $sp^3d$  hybridized compound is Trigonal (d) 9. bipyramidal. (d) In H - C = C - O - H the asterisked carbon has a valency of 10. 5 and hence this formula is not correct. (d)  $dsp^{3}$  hybrid orbitals have bond angles  $120^{\circ}, 90^{\circ}$ . 11. (a)  $\ln BeF_3^2$ , Be is not  $sp^3$  -hybridised it is  $sp^2$  hybridised. 13. (c) In molecule  $OF_2$  oxygen is  $sp^3$  hybridised. 17. In  $sp^3$  hybrid orbitals *s*-character is 1/4<sup>e</sup> means 25%. 18.  $XeF_4$  molecule has 'Xe'  $sp^3d^2$  hybridised and its shape is 19 (**d**) square planar. 20. (b) The bond angle is maximum for sp hybridisation because two *sp* hybridised orbitals lies at angle of  $180^{\circ}$ .  $C_2H_4Br_2$  has all single bonds so C-H bond distance is 21. (c) the largest. In methane molecule C is  $sp^3$  hybridised so its shape will be 23. (a) tetrahedral. (c) In compound  $\overset{3}{CH_2} = \overset{2}{C} = \overset{1}{CH_2}$  the second carbon *sp*-24. hybridised. (a)  $: \overset{\,\,{}_\circ}{Cl} \cdot \overset{\,\,{}_\circ}{Cl} :$  is the correct electronic formula of  $Cl_2$  molecule 25. because each chlorine has 7 electrons in its valence shell.  $XeF_4$  has  $sp^3d^2$  hybridisation, its shape is square planar. 26. (a) (b) In *HCHO*, carbon is  $sp^2$  hybridized 27.  $H - \overset{|}{C_2} = O$ (c) Because of the triple bond, the carbon-carbon bond distance in 28. ethyne is shortest. (b) The hybridisation of Ag in complex  $[Ag(NH_3)_2]^+$  will be sp 29. because it is a Linear complex. Structure of  $CO_2$  is linear O = C = O while that of  $H_2O$ 30. (a) H *i.e.* bent structure so in  $CO_2$  resultant dipole moment is zero while that of  $H_2O$  has some value.
- **31.** (d)  $CO_2$  is not  $sp^3$  hybridised, it is *sp* hybridised.

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UNIV	ERSAL	138 Chemical Bonding			
32.	(a)	As compare to pure atomic orbitals, hybrid orbitals have low energy.	70.	(a)	As <i>p</i> -character increases the bond angle decreases.
33.	(d)	$CH_{2}^{sp^{2}} = C = CH - CH_{3}^{sp^{3}}$ 1, 2-butadiene.			In $sp$ - <i>p</i> -character $\frac{1}{2}$ , bond angle - $180^{\circ}$
36.	(b)	$CCl_4$ is $sp^3$ hybridised so bond angle will be approximately			In $sp^2$ - <i>p</i> -character $\frac{2}{3}$ , bond angle - $120^\circ$
		109°.			$l_{\rm m}$ sm <sup>3</sup> = shared as $\frac{3}{1000}$ hard and $\frac{1000}{1000}$
40.	(b)	Ethene has ${\it sp}^2$ hybridised carbon so bond angles are $120^o$ .			$\frac{1}{4}$ , bond angle - 109
		9	71.	(a)	$sp^3$ -hybridization called tetrahedral because it provides
44.	(a)	Acetate ion is $CH_3 \in C - O$ single bond	72	(a)	Satom in SF, has $sn^3d^2$ hybridisation So the structure of
		and one $C = O$ double bond.	,	(u)	$SF_6$ will be octahedral.
46.	(c)	Benzene has all carbons $sp^2$ hybridised and planar in shape.	74.	(b)	Structure of $H_2O_2$ is non-planar. It has open book structure.
47.	(d)	In methane C is $sp^3$ hybridized and bond angle is $109^{\circ}$ .	75.	(d)	Structure of $N_2O_1$ is similar to $CO_2$ both have linear
	(-)	Н Н Н			structure.
56.	(d)	H - C - C - C - H	78.	(a)	$SnCl_2$ is V-shaped.
		$\begin{matrix} &   &   \\ H & H & H \end{matrix}$	79.	(d)	In $NH_4^+$ nitrogen is $sp^3$ hybridised so 4 hydrogen situated
		There are 10 shared pairs of electrons.	81.	(c)	Increasing order of bond angle is $sp^3 < sp^2 < sp$ .
58.	(a)	The diborane molecule has two types of $B - H$ bond : (i) $B - H$ It is a normal equalent hand	0	(-)	
		(i) $B - H_1$ = it is a normal covariat bond. (ii) $R - H_1$ = it is a three control hand	84. 86	(a)	$NH_4^+$ has $sp^3$ –hybridized nitrogen so its shape is tetrahedral.
		(ii) $D = H_b$ - it is a three centred bond.	80.	(6)	Bond angle increases with change in hybridisation in following order $sp^3 < sp^2 < sp$ .
		$H_t$ $H_t$	88.	(c)	In Diborane boron shows $sp^3$ –hybridization.
			89.	(e) (a)	Alkene does not show linear structure but it has planar
		$H_t$ $H_b$ $t$	<b>)</b>		structure due to $sp^2$ –hybridisation.
61.	(b)	$PF_5$ involves $sp^3d$ hybridization and hence has trigonal	90.	(c)	Generally $SF_4$ consist of 10 electrons, 4 bonding electron pair
					and one lone pair of electron, hence it shows $sp^{3}d$
62.	(c)	s-character in $sp = \frac{1}{2} \times 100 = 50\%$	92.	(c)	Atom/Ion Hybridisation
		s-character in $sp^2 = \frac{1}{2} \times 100 = 33.3\%$			NO <sup>+</sup> <sub>2</sub> sp
		3			$SF_4$ $sp^3d$ with one lone pair of electron
		<i>s</i> -character in $sp^3 = \frac{1}{4} \times 100 = 25\%$			$PF_6^ sp^3d^2$
		Hence, maximum <i>s</i> -character is found in <i>sp</i> -hybridisation.	93.	(a)	$P\!F_3$ consist of three bonding pair electrons and one lone pair
63.	(b)	The molecule of $PCl_5$ has $sp^3d$ hybridisation, structure is			of electron hence it shows ${sp}^3$ – hybridization.
64	( <b>b</b> )	trigonal bipyramidal.	94.	(b)	$NO_2^+$ shows <i>sp</i> -hybridization. So its shape is linear.
04.	(0)	form new orbitals is known as hybridisation and the new	95.	(c)	Generally octahedral compound show $sp^3d^2$ – hybridization.
		orbital formed are known as hybrid oribitals. They have similar energy.	96.	(a)	In fifth group hydride bond angle decreases from top to
65.	(b)	In $SO_3$ sulphur is $sp^2$ hybridized so its shape will be trigonal planar			bottom $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$ .
66	(a)	These all are triangular with $sp^2$ hybridization	97.	(b)	Generally $N\!H_4^+$ shows $sp^3$ hybridization.
67.	(c)	Bond length depends upon bond order and in benzene all	98.	(b)	We know that single, double and triple bond lengths of carbon
	. /	C - C bonds have same bond order.			in carbon dioxide are $1.22\text{\AA}, 1.15\text{\AA}$ and 1.10Å respectively.
68.	(b)	In $C_2H_2$ each carbon has $sp$ -hybridization	99.	(b)	It shows ${\it sp}^2$ –hybridization so it is planar.
		$H - C \equiv C - H$	101.	(a)	Bond angle of hydrides decreases down the group.

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- 102. (b) Hybridization of N in  $NH_3$  is  $sp^3$  that of Pt in  $[PtCl_4]^{2-}$  is  $dsp^2$  that P in  $PCl_5$  is  $sp^3d$  and that of B in  $BCl_3$  is  $sp^2$ .
- **103.** (d)  $NH_4^+$  and  $SO_4^{2-}$  both show  $sp^3$  –hybridization and tetrahedral structure.
- **104.** (a) It is shows  $sp^3d^3$  –hybridization. Hence the bond angle is about  $72^o$ .
- **107.** (a) *s*-character increases with increase in bond angle. Hybridization *s*% Angle

sp	50	$180^{o}$
$sp^2$	33.3	$120^{o}$
sp <sup>3</sup>	25	109.28°
$sp^3d^1$	20	$90^o$ and $120^o$

- **108.** (b)  $IF_7$  molecule show  $sp^3d^3$  –hybridization.
- **110.** (a)  $PCl_3$  contain three bonding and one lone pair electron. Hence shows  $sp^3$  –hybridization.
- **111.** (a) Ammonia and  $(BF_4)^{-1}$  shows  $sp^3$  –hybridization.
- **112.** (b) For square planar geometry hybridization is  $dsp^2$  involving  $s, p_x, p_y$  and  $d_{x^2-y^2}$  orbital.
- **113.** (b) All carbon atoms of benzene consist of alternate single and double bond and show  $sp^2$  hybridization.
- **116.** (c)  $BCl_3$  molecule show  $sp^2$ -hybridization and planar structure.
- **117.** (c)  $BCl_3$  Boron trichloride molecule show  $sp^2$  –hybridization and trigonal planar structure.

**118.** (b)  $SO_2$  molecule shows  $sp^2$  –hybridization and bent structure.

- **119.** (c) Due to multiple bonding in  $N_2$  molecule.
- **120.** (a) % of *s*-character in

$$CH_{4} = \frac{100}{4} = 25, \quad C_{2}H_{4} = \frac{100}{3} = 32$$

$$C_{2}H_{2} = \frac{100}{2} = 50$$

- 121. (a) Acidic character increases when we come down a group, so *HI* is the strongest acid.
- 122. (c)  $SO_2$  has  $sp^2$  hybridization have the V shape structure (<120°) due to 2 lone pair of electron over S atom.  $CO_2$  and  $N_2O$  have the sp hybridization.
- 123. (a) In  $H_2CO_3$  and  $BF_3$  central atom are in  $sp^2$  hybridization but in  $H_2CO_3$  due to the ionic character of O-H bond it will be polar (High electronegativity of oxygen).
- **124.** (a) Due to  $sp^3$  hybridization and presence of lone pair of electron on *p* atom *PCl*<sub>3</sub> are of pyramidal shape like that of *NH*<sub>3</sub>.

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- **125.** (b) There is sp hybridization in  $C_2H_2$  so it has the linear structure.
- 126. (c) In octahedral molecule six hybrid orbitals directed towards the corner of a regular octahedron with a bond angle of 90°.



- **127.** (d)  $sp^3d^2$  hybrid orbital have octahedral shape
- **128.** (c) In the formation of  $d^2sp^3$  hybrid orbitals two (n-1)d orbitals of *e.g.*, set [*i.e.*,  $(n-1)dz^2$  and  $(n-1)dx^2 y^2$  orbitals] one *ns* and three *np* [ $np_x$ ,  $np_y$  and  $np_z$ ] orbitals combine together and form six  $d^2sp^3$  hybrid orbitals.
- 129. (c) The correct order of bond angle (Smallest first) is

$$H_2S < NH_3 < SiH_4 < BF_3$$
  
92.6° < 107° < 109°28' < 120°

92.6





130.

131.



Square planar





Square planar

(b) See saw shaped



**132.** (b) In the formation of  $BF_3$  molecule, one *s* and 2*p* orbital hybridise. Therefore it is  $sp^2$  hybridization.

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5d

5d

2p



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9.

10.

11.

14.

17.

18

22.

23.

31.

(111)

- 148. (d)  $MX_3$  show the  $sp^2$  hybridization in which  $3sp^2$  hybridized orbital of M bonded by 3X from  $\sigma$  bond and having the zero dipole moment.
- **149.** (bcd)  $SnCl_2$  has V-shaped geometry.
- **150.** (a)  $NF_3$  is predominantly covalent in nature and has pyramidal structure (the central atom is  $sp^3$  hybridised) with a lone pair of electrons in the fourth orbital.
- **151.** (ac)  $PCl_3$ ,  $NH_3 \rightarrow$  Pyramidal.

 $CH_4, CCl_4 \rightarrow$  Tetrahedral.

**152.** (a)  $dsp^3$  or  $sp^3d$ : one  $s^+$  three  $p^+$  one  $d(d_{2})$ .

#### Resonance

1. (d) Choice (a), (b), (c) are the resonance structures of  $CO_2$ .

**2.** (b) In  $NH_3$  nitrogen has one lone pair of electron.

5. (b) In  $CN^-$  ion formal negative charge is on nitrogen atom due to lone pair of electrons.

- 7. (a)  $CH_3 C = CH_2$  has  $9\sigma$ ,  $1\pi$  and 2 lone pairs.
- 8. (c) In resonance structure there should be the same number of electron pairs.
- **9.** (b) There are three resonance structure of  $CO_3^{2-}$  ion.

$$o \stackrel{C}{\frown} o^{-}$$

**11.** (abcd) It has all the characteristics.

#### VSEPR Theory

- 2. (a) The bond angle in  $PH_3$  would be expected to be close to  $90^{\circ}$ . (The bond angle H P H in  $PH_3$  is  $93^{\circ}$ )
- **3.** (b) In  $BF_3$  molecule Boron is  $sp^2$  hybridised so its all atoms are co-planar.
- 4. (c) Due to lp-lp repulsions, bond angle in  $H_2O$  is lower  $(104^{\circ}.5^{\circ})$  than that in  $NH_3$   $(107^{\circ})$  and  $CH_4(109^{\circ}28')$ .  $BeF_2$  on the other hand, has *sp*-hybridization and hence has a bond angle of  $180^{\circ}$ .
- 5. (c) Compound is carbontetrachloride because  $CCl_4$  has  $sp^3$  hybridization 4 orbitals giving regular tetrahedron geometry. In others the geometry is little distorted inspite of  $sp^3$  hybridization due to different atoms on the vertices of tetrahedron.
- **6.** (b)  $SO_4^{2-}$  ion is tetrahedral since hybridization of S is  $sp^3$ .
- (b) NH<sub>3</sub> molecule has one lone pair of electrons on the central atom *i.e.* Nitrogen.
- 8. (c)  $C_2H_2$  has linear structure because carbons are *sp*-hybridised and lies at  $180^{\circ}$ .

#### $XeF_6$ is distorted Octahedral. It has $sp^3d^3$ hybridisation (b) with lone pair of electron on Xe, so its shape is distorted. (a) 5p(c) Xe ground state 11 11 11 11 Xe double excitation 11 1 1 11 11 5dXeF<sub>4</sub> 11 11 11 11 11 11 $sp^3d^2$ - hybridization

- 12. (a)  $CO_2$  has bond angle  $180^{\circ}$ .
- (a) As the s-character of hybridized orbitals decreases the bond angle also decreases
  - In  $sp^3$  hybridisation: *s*-character 1/4, bond angle  $109^o$

In  $sp^2$  hybridisation: *s*-character 1/3, bond angle  $120^{\circ}$ 

- In *sp* hybridisation: *s*-character 1/2, bond angle  $180^{\circ}$
- (a)  $XeF_2$  molecule is Linear because Xe is sp hybridised.
- 15. (c)  $SO_4^2$  has 42 electrons;  $CO_3^2$  has 32 electrons;  $NO_3^-$  has 32 electrons.
- (c) Molecular oxygen contains unpaired electron so it is paramagnetic (according to MOT).
  - (b) Structure of  $H_2O$  is a bent structure due to repulsion of lone pair of oxygen.

(d) Bond angle between two hybrid orbitals is  $105^{\circ}$  it means orbitals are  $sp^3$  hybridised but to lone pair repulsion bond angle get changed from  $109^{\circ}$  to  $105^{\circ}$ . So its % of *s*-character is between 22-23%.

- (d) Number of electrons in  $ClO_2^-$ = 7 + 6 + 6 + 1 = 20
  - Number of electrons in  $ClF_2^+ = 7+7+7 1=20$ .
- (b) Central atom having four electron pairs will be of tetrahedral shape.



- **26.** (c) It shows  $sp^2$ -hybridization and show trigonal planar structure.
- **28.** (b)  $H_2S$  show bond angle nearly  $90^\circ$ .
  - (a) Bond angle of hydrides is decreases top to bottom in the group.  $N\!H_3>P\!H_3>AsH_3>SbH_3$

**32.** (c) 
$$\begin{pmatrix} \circ & \circ \\ N \end{pmatrix}$$
 Three bond pair and one lone pair of electron.  
 $\begin{pmatrix} & & \\ & & \\ & & \\ & & \\ & & H \end{pmatrix}$   $H$   $H$   $H$ 

**33.** (c) Unpaired electrons are present in  $KO_2$  while others have paired electron

 $NO_2^+$  = 22 electrons ;  $BaO_2$  = 72 electrons

 $AlO_2 = 30$  electrons ;  $KO_2 = 35$  electrons

**34.** (a) Bond angle decreases from  $H_2O$  to  $H_2Te$  .

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2.

11.

12.

13.

18.

here

## 142 Chemical Bonding

- $BF_3$  does not contain lone pair of electron. 35. (c)
- 36. (b)

Bent T-shaped geometry in which both lone pairs occupy the equatorial position of the trigonal bipyramidal  $(l_p - l_p)$  repulsion = 0  $(l_p - b_p)$  repulsion = 4 and

$$(b_n - b_n)$$
 repulsion =2

The overall value of the dipole moment of a polar molecule 37. (b) depends on its geometry and shape *i.e.*, vectorial addition of dipole moment of the constituent bonds water has angular structure with bond angle 105° as it has dipole moment. However  $BeF_2$  is a linear molecule since dipole moment summation of all the bonds present in the molecule cancel each other.

$$\begin{array}{ccc}
\uparrow & & & \\
O & & & F \xleftarrow{} Be & \overleftrightarrow{} F \\
\end{array}$$

- $BC_{H_3}$ ,  $BBr_3$  and  $BF_3$ , all of these have same structure *i.e.* 38. (d) trigonal planar ( $sp^2$  hybridization) Hence bond angle is same for all of them (*i.e.*, equal to 120°)
- 39. (d) We know that molecule of  $(NH_3)$  has maximum repulsion due to lone pair of electron. Its shape is pyramidal and is  $sp^3$  hybridization.

**40.** (b) 
$$: O:$$
  
 $H$   $: O:$   
 $H$   $: O:$   $: O$ 

As the electronegativity of central atom decreases bond angle is decreases

- $\therefore$  *NH*<sub>3</sub> has largest bond angle.
- (c) In  $NH_3$ ,  $sp^3$  -hybridization is present but bond angle is 41. 106°45′ because Nitrogen has lone pair of electron according to VSEPR theory due to *bp-lp* repulsion bond angle decreases from  $109^{\circ}45'$  to  $106^{\circ}45'$ .
- Bond strength decreases as the size of the halogen 42. (a) increases from *F* to *I*.
- $NH_3$  has pyramidal structure, yet nitrogen is  $sp^3$  hybridised. (b) 43 This is due to the presence of lone pair of electron.
- $SiF_4$  has symmetrical tetrahedral shape which is due to  $sp^3$ (c) 44 hybridization of the central sulphur atom in its excited state configuration.  $SF_4$  has distorted tetrahedral or Sea- Saw

geometry which arise due to  $sp^3d$  hybridization of central sulphur atom and due to the presence of lone pair of electron in one of the equatorial hybrid orbital.



#### Molecular orbital theory

(c) B.O. = 
$$\frac{\text{No.of bonding } e^- - \text{No. of antibonding}}{2}$$

$$=\frac{8-3}{2}=\frac{5}{2}=2.5$$

з. (b) One bonding M.O. and one anti-bonding M.O.

- (b)  $O_2^{2-}$  is least stable. 4.
- (c) B.O. of  $O_2$  is 2, B.O. of  $O_2^{-1}$  is 1.5, B.O. of  $O_2^{+1}$  is 2.5 and of 5.  $O_2^{2-}$  is 1.
- (d) Hydride of boron does not exist in  $BH_3$  form. It is stable as its 6. dimer di borane  $(B_2H_6)$ .
- $O_2^-(2 \times 8 + 1 = 17)$  has odd number of electrons and hence 10. (c) it is paramagnetic. All the remaining molecules/ions, i.e.,  $CN^{-}(6 \pm 7 + 1 = 14)$  diamagnetic

NO(7 + 8 = 15) has odd number of electrons and hence it is paramagnetic.

(c) B.O. = 
$$\frac{\text{No. of } N_b - \text{No. of } N_a}{2} = \frac{5}{2} = 2.5$$
.

(b) Bond order of  $O_2^+$  is highest so its bond length is smallest.

Oxygen is paramagnetic due to the presence of two unpaired electron :

$$O_{2} = \sigma(1s)^{2} \sigma^{*}(1s)^{2} \sigma(2s)^{2} \sigma^{*}(2s)^{2}$$
  
$$\sigma(2p_{x})^{2} \pi(2p_{y})^{2} \pi(2p_{x})^{2} \pi^{*}(2p_{y})^{1} \pi^{*}(2p_{z})^{1}$$

In  $CH_3CN$  bond order between C and N is 3 so its bond (d) length is minimum. (b)

$$He_{2}^{+} H_{2} H_{2}^{+} H_{2}^{-}$$

$$\sigma(1s) \qquad \uparrow \downarrow \qquad \uparrow \downarrow \qquad \uparrow \downarrow \qquad \uparrow \downarrow^{-}$$

$$s \qquad \sigma(1s) \qquad \uparrow \downarrow \qquad \uparrow \downarrow \qquad \uparrow \downarrow \qquad \uparrow \downarrow^{-}$$

$$B.O. \qquad \frac{1}{2} \qquad 1 \qquad \frac{1}{2} \qquad \frac{1}{2}$$
Magnetic   
P D P P
nature

(P = Paramagnetic, D = Diamagnetic)

(c) Due to unpaired  $e^- ClO_2$  is paramagnetic. 19.

The Bond order in  $N_2$  molecule is 3,  $N \equiv N$  Here, 20 (c)  $N_b = 2 + 4 + 2 = 8$  and  $N_a = 2$ 

: B.O. = 
$$(8-2)/2 = 3$$
.

- (d)  $H_2^+$  has the bond order  $\frac{1}{2}$ , it has only one electron so it will 21. be paramagnetic.
- 22. When bond forms between two atom then their energy get (c) lower than that of separate atoms because bond formation is an exothermic process.
- Valency of A is 3 while that of B is 2 so according to Criss 23. (b) Cross rule the formula of the compound between these two will be  $A_2B_3$ .
- Due to resonance bond order of C C bonds in benzene is 24. (c) between 1 and 2.

- 25. (a) Nitrogen does not have vacant 'd-orbitals so it can't have +5 oxidation state i.e. the reason  $PCl_5$  exists but  $NCl_5$  does not.
- $\label{eq:constraint} \textbf{26.} \qquad (d) \quad \text{Molecules having unpaired electrons show paramagnetism.}$
- **27.** (b)  $NO_2$  has unpaired electrons so it would be paramagnetic.
- **30.** (c) Helium molecule does not exist as bond order of  $He_2 = 0$ .
- **31.** (c) Structure of  $P_4O_{10}$  is



Each phosphorus is attached to 4 oxygen atoms.

**33.** (c) B.O. of carbon 
$$= \frac{N_b - N_a}{2} = \frac{8 - 4}{2} = 2$$

**34.** (a) B.O. 
$$=\frac{N_b - N_a}{2} = \frac{10 - 4}{2} = 3$$

- **37.** (b) B.O.  $=\frac{N_b N_a}{2} = \frac{8 3}{2} = \frac{5}{2} = 2.5$ .
- **38.** (a) Electronic configuration of  $O_2$  is  $O_2 = \sigma(1s)^2 \sigma^*(1s)^2 \sigma(2s)^2 \sigma^*(2s)^2 \sigma(2p_x)^2 \pi(2p_y)^2$   $\pi(2p_x)^2 \sigma^*(2p_x)^1 \sigma^*(2p_x)^1$

$$\pi (2p_z)^2 \pi^2 (2p_y)^2 \pi^2 (2p_z)^2$$

The molecule has two unpaired electrons So, it is paramagnetic

- **40.** (c)  $\pi 2p_y$  has two nodal planes.
- 42. (a) Element with atomic number 26 is *Fe*. It is a ferromagnetic.
  43. (b) Correct Sequence of bond order is
  - (b) Correct Sequence of bond order is  $Q_{+}^{+} > Q_{+} > Q_{-}^{2-}$

$$B.O - 2.5$$
 2 1.5

- **44.** (a) Due to small bond length.
- **45.** (a)  $S^{-2}$  have all paired electrons so it is diamagnetic.
- **46.** (c) *NO* has 15 electrons.
- **47.** (b) In the conversion of  $O_2$  into  $O_2^-$  bond order decreases.
- **49.** (c)  $O_2^{2-}$  does not have any unpaired electron so it is diamagnetic.
- **50.** (a)  $O_2^{2-}$  consist of four antibonding electron pair [1s and 2s have two antibonding and  $2p_x 2p_y$  have two antibonding electron pair].
- **51.** (c) The electron's distribution in molecular orbitals is  $1s^2$ ,  $2s^1$

B.O. 
$$=\frac{2-1}{2}=\frac{1}{2}=0.5$$

**52.** (b)  $ClO_2^-$  has all paired electrons hence it does not show paramagnetism.

53. (a) B.O. 
$$= \frac{1}{2} [N_b - N_a]$$
  
 $N_2 = \frac{1}{2} [10 - 4] = \frac{6}{2} = 3; \quad O_2^{2+} = \frac{1}{2} [10 - 4] = \frac{6}{2} = 3.$   
54. (a) B.O. for  $N_2^+ = \frac{1}{2} [N_b - N_a] = \frac{1}{2} [9 - 4] = \frac{5}{2} = 2.5.$ 

- Chemical Bonding 143
- **55.** (a)  $H_2O_2$  contain bond angle between two O-H planes about  $90^o$ .
- (c) Nitrogen molecule has highest bond energy due to presence of triple bond.
- 57. (c)  $Cu^{2+} = [Ar_{18}]3d^94s^0$  it has one unpaired electron so it is paramagnetic.

**59.** (a) 
$$CN^- = 14$$
 electrons;  $CO = 14$  electrons

B.O. =  $\frac{1}{2}[10-4] = \frac{6}{2} = 3$ .

**60.** (a) B.O. 
$$=\frac{1}{2}[10-5] = \frac{5}{2} = 2.5$$
, paramagnetic

64. (c) The paramagnetic property in oxygen came through unpaired electron which can be explained by molecular orbital theory.



**66.** (c) We know that carbonate ion has following resonating structures

Bond order =  $\frac{\text{Total number of bonds between atoms}}{\text{Total number of resonating structure}}$ 

$$=\frac{1+1+2}{3}=\frac{4}{3}=1.33.$$

7. (a) 
$$O_2(15e^{-}) = K : K (\sigma 2s)^2 (\sigma^{-} 2s)^2 (\sigma 2p_x)^2$$
  
 $(\pi 2p_y)^2 (\pi 2p_z)^2 (\pi^* 2p_y)^1 (\pi^* 2p_z)^0$   
Hence, bond order  $= \frac{1}{2}(10-5) = 2.5$   
 $N_2^+(13e^{-}) = KK^* (\sigma 2s)^2 (\sigma^* 2s)^2 (\sigma 2p_x)^2$   
 $(\pi 2p_y)^2 (\pi 2p_z)^1$   
Hence, bond order  $= \frac{1}{2}(9-4) = 2.5$ .

**68.** (a) Electronic configuration of  $O_2$  is

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#### F SCORER 144 Chemical Bonding

$$O_{2} = (\sigma 1s)^{2} (\sigma^{*} 1s)^{2} (\sigma 2s)^{2} (\sigma^{*} 2s)^{2} (\sigma^{*} 2s)^{2} (\sigma 2p_{z})^{2}$$
$$(\pi 2p_{x}^{2} \equiv \pi 2p_{y}^{2}) (\pi^{*} 2p_{x}^{1} \equiv \pi^{*} 2p_{y}^{1})$$
Hence bond order 
$$= \frac{1}{2} [N_{b} - N_{a}] = \frac{1}{2} [10 - 6] = 2.$$

- **69.** (c) Nitrogen form triple bond  $N \equiv N$ In which 6 electron take part.
- 70. (a) As bond order increase bond length decrease the bond order of species are
  - $=\frac{\text{number of bonding electron Number of } a.b. \text{ electron}}{2}$

For 
$$O_2 = \frac{10-6}{2} = 2$$
;  
 $O_2^+ = \frac{10-5}{2} = 2.5$   
 $O_2^- = \frac{10-7}{2} = 1.5$ 

So, bond order  $O_2^+ > O_2^- > O_2^-$  and bond length are  $O_2^+ > O_2^- > O_2^-$ .

**71.** (b) 
$$O_2: \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_x^2 \begin{cases} \pi^2 2p_y^2 \\ \pi^2 2p_z^2 \end{cases} \begin{cases} \pi^* 2p_y^1 \\ \pi^* 2p_z^1 \end{cases}$$

Bond order  $=\frac{10-6}{2}=2.0$ 

(Two unpaired electrons in antibonding molecular orbital)

$$O_{2}^{+}:\sigma 1s^{2},\sigma^{*} 1s^{2},\sigma 2s^{2},\sigma^{*} 2s^{2},\sigma 2p_{x}^{-2}\begin{vmatrix} \pi^{2} 2py^{2} \\ \pi^{2} 2pz^{2} \end{vmatrix} \begin{pmatrix} \pi^{*} 2py^{1} \\ \pi^{*} 2pz^{2} \\ \pi^{*} 2pz^{0} \end{vmatrix}$$
  
Bond order =  $\frac{10-5}{2} = 2.5$ 

(One unpaired electron in antibonding molecular orbital so it is paramagnetic)

- 72. (b) Higher the bond order, shorter will be the bond length, thus  $NO^+$  having the higher bond order that is 3 as compared to NO having bond order 2 so  $NO^+$  has shorter bond length.
- **73.** (d) Oxygen molecule  $(O_2)$  boron molecule  $(B_2)$  and  $N_2^+$  ion, all of them have unpaired electron, hence they all are paramagnetic.
- **74.** (c) Bond order of  $NO^+$ , NO and  $NO^-$  are 3, 2.5 and 2 respectively, bond energy  $\infty$  bond order
- **75.** (a) Paramagnetic property arise through unpaired electron.  $B_2$  molecule have the unpaired electron so it show paramagnetism.

$$B_{2} \rightarrow \sigma 1s^{2}\sigma^{*}1s^{2}, \sigma 2s^{2}\sigma^{*}2s^{2}, \pi 2p_{x}^{-1} = \pi 2p_{y}^{-1}$$
(2 umpaired electron)  

$$C_{2} \rightarrow \sigma 1s^{2}\sigma^{*}1s^{2}, \sigma 2s^{2}\sigma^{*}2s^{2}, \pi 2p_{x}^{-2}, \pi 2p_{y}^{-2}$$
(No unpaired electron)  

$$N_{2} \rightarrow \sigma 1s^{2}\sigma^{*}1s^{2}, \sigma 2s^{2}\sigma^{*}2s^{2}, \sigma 2p_{x}^{-2}, \pi 2p_{y}^{-2}\pi 2p_{z}^{-2}$$
(No unpaired electron)  

$$F_{2} \rightarrow \sigma s^{2}, \sigma^{*}1s^{2}, \sigma 2s^{2}, \sigma^{*}2s^{2}, \sigma 2p_{x}^{-2}, \pi 2p_{y}^{-2}, \pi 2p_{z}^{-2},$$
(No unpaired electron)  

$$\pi^{*}2p_{y}^{-2}, \pi^{*}2p_{z}^{-2}$$

So only  $B_2$  exist unpaired electron and show the paramagnetism.

0 1

**76.** (b) 
$$O_2 \to \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x \begin{cases} \pi 2p_y \\ \pi 2p_z \end{cases} \begin{cases} \pi 2p_y \\ \pi 2p_z \end{cases} \frac{\pi}{\pi} 2p_z^2 \end{cases}$$

So two unpaired electron found in  $O_2$  at ground stage by which it shows paramagnetism.

**77.** (b) Due to greater electron affinity 
$$Cl_2$$
 has the highest bond energy.

(a) Molecular orbital electronic configuration of these species are :  

$$O_{2}^{-}(17e^{-}) = \sigma 1s^{2}\sigma^{*} 1s^{2}, \sigma 2s^{2}\sigma^{*} 2s^{2}, \sigma 2p_{x}^{2}, \pi 2p_{y}^{2}, \\ \pi 2p_{z}^{2}, \pi^{*} 2p_{y}^{2}\pi^{*} 2p_{z}^{1} \\ O_{2}(16e) = \sigma 1s^{2}\sigma^{*} 1s^{2}, \sigma 2s^{2}\sigma^{*} 2s^{2}, \sigma 2p_{x}^{2}, \pi 2p_{y}^{2}, \\ \pi 2p_{z}^{2}\pi^{*} 2p_{y}^{1}\pi^{*} 2p_{z}^{1} \\ O_{2}^{2^{-}}(18e) = \sigma 1s^{2}\sigma^{*} 1s^{2}, \sigma 2s^{2}\sigma^{*} 2s^{2}, \sigma 2p_{x}^{2}, \pi 2p_{y}^{2}, \\ \pi 2p_{z}^{2}\pi^{*} 2p_{y}^{1}\pi^{*} 2p_{z}^{1} \\ O_{2}^{2^{-}}(18e) = \sigma 1s^{2}\sigma^{*} 1s^{2}, \sigma 2s^{2}\sigma^{*} 2s^{2}, \sigma 2p_{x}^{2}, \pi 2p_{y}^{2}, \\ \pi 2p_{z}^{2}\pi^{*} 2p_{y}^{2}\pi^{*} 2p_{z}^{2} \\ \end{array}$$

Hence number of antibonding electrons are 7,6,and 8 respectively.

- (c) Species with unpaired electrons is paramagnetic  $O_2$  has 2 unpaired electrons,  $O_2^-$  has one unpaired,  $O_2^{2^-}$  has zero unpaired electrons,  $O_2^{2^+}$  has one unpaired.
- (a)  $O_2$  has 2 unpaired electron while  $O_2^+$  and  $O_2^-$  has one each unpaired electrons while  $O_2^{2+}$  does not have any unpaired electron.

(c) 
$$H - O - O - H$$
,  $O \leftarrow O = O$ ,  $O = O$ 

$$\mathcal{A}_{o}^{O} \longleftrightarrow \mathcal{A}_{o}^{O} \longleftrightarrow \mathcal{A}_{o}^{O} \mathsf{A}_{o}^{O} \mathsf{A}_{o}^{O}$$

Due to resonance in  $O_3 O - O$  bond length will be in b/w O = O and O - O.

82. (a) From valency bond theory, bond order in *CO*, *i.e.* :  $C \equiv O$ : is 3, that of O = C = O is 2 while that of  $CO_3^{2-}$  ion is 1.33. Since the bond length increases as the bond order decreases, *i.e.*  $CO < CO_2 < CO_3^{2-}$ .

**83.** (c) 
$$N_2 : KK\sigma(2s)^2 \sigma * (2s)^2 \pi (2p_x)^2 \pi (2p_y)^2 \sigma (2p_z)^2$$

(diamagnetic)

$$C_{2}: KK\sigma(2s)^{2}\sigma^{*}(2s)^{2}\pi(2p_{x})^{2}\pi(2p_{y})^{2} \qquad (\text{diamagnetic})$$
  
$$N_{2}^{+}: KK\sigma(2s)^{2}\sigma^{*}(2s)^{2}\pi(2p_{x})^{2}\pi(2p_{y})^{2}\sigma(2p_{z})^{2}$$

(paramagnetic)

$$O_2^{2-}: KK\sigma(2s)^2 \sigma^*(2s)^2 \sigma(2p_z)^2 \pi(2p_x)^2 \pi(2p_y)^2$$

 $\pi^* (2p_x)^2 \pi^* (2p_y)^2$  (diamagnetic)

**84.** (d) 
$$NH_3 = 107^\circ$$
,  $PH_3 = 93^\circ$ ,  $H_2O = 104.5^\circ$   
 $H_2Se = 91^\circ$ ,  $H_2S = 92.5^\circ$ 

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#### Chemical Bonding 145

SELF SCORE

Hydrogen bonding

- (d) Hydrogen bonding will be maximum in *F-H* bond due to greater electronegativity difference.
- **2.** (b) Ice has hydrogen bonding.
- **3.** (b) H F has highest boiling point because it has hydrogen bonding.
- **6.** (d)  $CO_2$  is *sp*-hybridised

elec

- 7. (b) sp-hybridization gives two orbitals at  $180^{\circ}$  with Linear structure.
- 8. (d) Hydrogen bonding increases the boiling point of compound.
- (c) *o*-Nitrophenol has intramolecular hydrogen bonding but *p*-Nitrophenol has intermolecular hydrogen bonding so boiling point of *p*-Nitrophenol is more than *o*-Nitrophenol.
- 10. (c) The strongest hydrogen bond is in hydrogen fluoride because the power of hydrogen bond ∝ electronegativity of atom and

tronegativity 
$$\propto \frac{1}{\text{atomic size}}$$

So fluorine has maximum electronegativity and minimum atomic size.

- **n.** (d)  $H_2O$  can form hydrogen bonds rest  $CH_4$  and  $CHCl_3$  are organic compound having no oxygen while *NaCl* has itself intraionic attraction in the molecule.
- 12. (b)  $PH_3$  has the lowest boiling point because it does not form Hydrogen bond.
- 14. (b) Hydrogen bonding increases heat of vaporisation.
- 15. (d) Only  $NH_3$  forms H-bonds.
- (a) Water molecule has hydrogen bonding so molecules get dissociated so it is liquid.
- 23. (d) In case of water, five water molecules are attached together through four hydrogen bonding.
- **25.** (c) Hydrogen bond is strongest in hydrogen fluoride.
- **28.** (c) Boiling point of  $H_2O$  is more than that of  $H_2S$  because  $H_2O$  forms hydrogen bonding while  $H_2S$  does not.

**30.** (c) Interamolecular *H*-bonding.

- 31. (a) Hydrogen bond is formed when hydrogen is attached with the atom which is highly electronegative and having small radius.
- 34. (a) Water is dense than ice because of hydrogen bonding interaction and structure of ice.
- 35. (a) Ethanol have hydrogen bonding so its boiling point is higher than its isomer dimethyl ether.
- (a) A compound having maximum electronegative element will form strong Hydrogen bond.
- **37.** (a) Due to electronegativity difference of  $N_2$  and  $H_2$ ,  $NH_3$  form hydrogen bond.
- 38. (b) Intermolecular hydrogen bonding compound contain more b.p. compare to intramolecular hydrogen bonding compound.
- **39.** (d) Water molecule contain hydrogen bonding.
- **40.** (c) It contain intermolecular hydrogen bonding.
- **41.** (b) Ethyl alcohol has a intermolecular hydrogen bond.
- **43.** (b) *HCl* contain weak covalent bond.
- (c) Due to intermolecular hydrogen bonding water molecules come close to each other and exist in liquid state.
- **46.** (b) Due to greater resonance stabilization.

- **47.** (d)  $C_2H_5OH$  will dissolve in water because it forms hydrogen bond with water molecule.
- (b) In ice cube all molecules are held by inter molecular hydrogen bond.
- 49. (d) Hydrogen bonding is developed due to inter atomic attraction so it is the weakest.

#### Types of bonding and Forces in solid

- (b) In electrovalent crystal has cation and anion are attached by electrostatic forces.
- (d) Mercury has very weak interatomic forces so it remains in liquid state.
- (c) The melting and boiling points of argon is low hence, in solid argon atoms are held together by weak Vander Waal's forces.
  - (c) NaF is the strongest ionic crystal so its melting point would be highest.
- (b) Diamond is the hardest substance it's melting point would be highest.
- 10. (c) Bond is formed by attractive and repulsive forces of both the atoms.
- (a) Generally zero group elements are linked by the Vander Waal's force. Hence these show weakest intermolecular forces.
- **13.** (d) Glycerol has a three *OH* group hence it is viscous in nature.
- 14. (c) Vander waal's forces is the weakest force of attraction.

16. (b)  $\overline{NH}_{4}^{+}$  contain all three types of bond in its structure

$$\begin{bmatrix} H \\ I \\ H - N \\ I \\ H \end{bmatrix}^{+}$$

- (d) In NaOH covalent bond is present in O-H bond while ionic bond is formed between  $OH^-$  and  $Na^+$ .
- (a) Bond formation is an exothermic reaction so there is decrease in energy of product.
- **22.** (d) Blue vitriol is  $CuSO_4 \cdot 5H_2O$  and it has all types of bonds.

**23.** (a) 
$$\begin{bmatrix} H \\ H \\ -N \\ H \end{bmatrix}^{+} Cl^{-}$$

lonic bond = 1, Covalent bond = 3 Co-ordinate bond = 1.

#### **Critical Thinking Questions**

- (d) We know that ionic characters =  $16 [E_A - E_B] + 3.5 \times [E_A - E_B]^2$ 
  - or ionic characters = 72.24%
- (c) Configuration of  $O_2$  molecule is

$$[\sigma(1s)^2 \sigma^*(1s)^2 \sigma(2s)^2 \sigma^*(2s)^2 \pi(2p_x)^2 \pi(2p_y)^2$$

 $\sigma(2p_{y})^{2}\pi^{*}(2p_{y})^{1}\pi^{*}(2p_{y})^{1}$ 

No. of pair are 7 so total no. of paired electrons are 14.

(a) 
$$H - \stackrel{\cdots}{O} :+ H^+ \rightarrow H - \stackrel{\cdots}{O} \rightarrow H$$
  
 $H \qquad H$ 

7. (b) The correct order of increasing dipole moment is

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#### NIVERSAL 146 Chemical Bonding

*p*-dichlorobenzene < Toluene < *m*-dichlorobenzene < *o*dichlorobenzene.

- (d) Ammonia molecule is more basic than nitrogen trifluoride and Boron trifluoride because ammonia molecule easily gives lone pair of electron.
- **11.** (a) Chlorine atom in  $ClO_2^-$  is  $sp^3$  hybridised but its shape is angular.
- 12. (c)  $[NF_3 \text{ and } H_3O^+]$  are pyramidal while  $[NO_3^- \text{ and } BF_3]$  are planar. Hence answer (c) is correct.

**13.** (d) 
$$CH_2 = CH_2 - CH_2 - CH_2 - C \equiv CH_3$$
  
 $SP^2 = SP^3$   
hybridised

- 14. (d) B.O. in *CO i.e.*, : C = O: is 3, that of O = C = O is 2 while that of  $CO_3^{2-}$  ion is 1.33. Since the bond length increases as the bond order decreases *i.e.*  $CO < CO_2 < CO_3^{2-}$ . Thus option (d) is correct.
- 15. (b) Dichromate dianion has following structure

$$\begin{bmatrix} O & O \\ \uparrow & \uparrow \\ O \leftarrow Cr - O - Cr \\ \downarrow & \downarrow \\ O & O \end{bmatrix}^2$$

6, Cr - O bonds are equivalent.

 $K_2[Fe(CN)_6]$ 

Trimer of  $SO_3$ .

- 17. (b)  $ClF_3$  is a  $[AB_3]$  type of molecule because it consist of three bonding pair and two lone pair of electrons hence this compound shows  $sp^3d$  hybridization.
- **20.** (a)  $BeF_3^-$  does not show  $sp^3$  –hybridization because this compound is not formed.
- **21.** (a)

24.

(d)

$$Fe_{26} = 4s^{2}3d^{6}$$

$$Fe^{3+} = 3d^{5}4s^{0}$$

$$= 111111$$

$$X \times X \times X \times X \times X \times X$$

Unpaired electron  $d^2sp^3$  – hybridization

- **22.** (d)  $N_2^+$  has one unpaired electron so it would be paramagnetic.
- 23. (a) Each of the species has 14 electron so isoelectronic and shows bond order 3.

B.O. 
$$= \frac{1}{2}[N_b - N_a] = \frac{1}{2}[10 - 4] = \frac{6}{2} = 3.$$

(c)  $CuSO_4.5H_2O$  has electrovalent, covalent and coordinate bonds.  $Cu^{2+} \begin{bmatrix} O \\ O^- - \stackrel{\uparrow}{\underset{O}{S}} \rightarrow \stackrel{\frown}{O} \end{bmatrix} .5H_2O$ . Assertion & Reason

- (a) Solubility in water depends on hydration energy and lattice energy.
- (a) Polarity in covalent bond developed due to shifting of electrons towards one of the bonded atoms.
  - (c)  $SiF_4$  have  $sp^3$  hybridization & shape of regular tetrahedral where the bond angle of



- (c)  $N_2$  molecule is diamagnetic. The diamagnetic character is due to the presence of paired electron  $N_2$  molecule does not contain any unpaired electron. Thus, assertion is coorect but the reason is false.
- (a) It is correct that during formation of Ice from water there are vacant spaces between hydrogen bonded molecules of Ice. Ice has a cage like structure. Due to this reason Ice is less dense than liquid water. hence both assertion & reason are true & reason are the correct explanation of assertion.
- (b) Water is liquid while  $H_2S$  is gas because oxygen is of small size & more electronegative in comparision to sulphur. Hence water molecules exist as associated molecules to form liquid state due to hydrogen bonding  $H_2S$  does not have hydrogen bonding & can't associated hence it is gas.
- (d) lodine is more soluble in  $CCl_4$  than in  $H_2O$  because iodine is non polar & thus it dissolve in  $CCl_4$  because like dissolves like.
- (a) *o* & *p* -nitrophenols can be separated by steam distillation because *o* -nitrophenol is steam volatile. Here, both assertion & reason are correct & reason is correct explanation of assertion.
- (e) Fluorine is highly reactive F-F bond has low bond dissociation energy. Here assertion is false but reason is true.
- **15.** (c) It is true that sigma  $(\sigma)$  bond is stronger than pi  $(\pi)$  bond but the reason that there is free rotation of atoms is false.
  - (c) Energy is released in the formation of the crystal lattice. It is qualitative measure of the stability of an ionic compound so assertion is true & reason are false.
- 17. (c) Li, Na & K are alkali metals & not alkaline earth metal so, size of alkali metal increases So. Assertion is true & reason are false.
  - (b) Hess's law states that the enthalpy of a reaction is the same, whether it takes place in a single step or in more than one step. In born haber cycle the formation of an cycle ionic compound may occur either by direct combination of the element or by a stepwise process involving vaporization of elements, conversion of the gaseous atoms into ions & the combination of the gaseous ions to form the ionic solid.

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**Chemical Bonding 147** 

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- With increase in bond order, bond length decreases & hence bond 19. (a) energy increases so both assertion & reason are true & reason are the correct explanation of assertion.
- (c) Electron affinity is experimentally measurable while 20. electronegativity is a relative number so assertion is true but reason are false.
- 21. (b) Assertion & reason both are correct but reason is not the correct explanation of assertion sulphur has five electrons pairs whose arrangement should be trigonal bipyramidal according to VSEPR theory. Two structure are possible

Lone position (three repulsion at 90°)

22. (e)  $BF_3$  has zero dipole moment because of its structure.

$$F \longleftarrow B \xrightarrow{F} \mu = 0$$

 ${\cal H}_2 S\,$  has two lone pairs on sulphur atom & hence. It has irregular shape.

repulsion)

L.p – b.p

Thus it possess dipole moment. So assertion is false but reason are true.

- 23. (d) Both assertion & reason are false because pairs of electron will have different spins. Electrons are equally shared between them.
- (d) In  $B_2$ , total number of electrons = 10 24.

 $B \to \sigma(\mathbf{1}s) \sigma^*(\mathbf{1}s) \sigma(\mathbf{2}s) \sigma^*(\mathbf{2}s) \sigma(\mathbf{2}p) \pi(\mathbf{2}p)$ Presence of unpaired electron shows the paramagnetic nature. The highest occupied molecular orbital is of  $\pi$ -type.

- (a) Both assertion & reason are true & reason is the correct 25. explanation of the assertion because. At any given instant, at room temperature each water molecules forms hydrogen bonds with other water molecules. The  $H_2O$  molecules are in continuous motion. So hydrogen bonds are constantly & rapidly broken & formed. In Ice  $H_2O$  molecules are however fixed in the space lattice.
- (a) Both assertion & reason are true & reason is the correct 26. explanation of assertion, because helium molecule is formed by linking two helium atoms. both have 1s orbitals. These will combine to form two molecular orbitals  $\sigma$  (1s) &  $\sigma^*$ (1s) four available electrons are accommodated as  $\sigma(1s)^2$  &  $\sigma^{*}(1s)^{2}$

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UNIV	150 Chemical Bonding						
	(b) One sigma ( $\sigma$ ) and two pi ( $\pi$ ) be (c) One sigma ( $\sigma$ ) and one and a hal	onds f pi $(\pi)$ bonds	28.	(a) 3 (c) 1 In the process, $O_2^+ \rightarrow O_2^+$	(b) (d)	2 1/2 electron lost is 1	from
22.	(d) One sigma ( $\sigma$ ) bond Which of the following resonating structure (a) $N \equiv N - O$ (b) (c) $N = N - O$ (d)	actures of $N_2O$ is the most coorkee Qualifying 1998] $N-N \equiv O$ N-N=O	29.	(a) Bonding $\pi$ -orbital (c) $2p_z$ orbital The maximum number	(b) (d) of hydroger	Antibonding 7 $2p_x$ orbital bonds forme	[ <b>Orissa JEE 2002</b> ] <i>T</i> -orbital ed by a water
23.	The hybridization of atomic orbitals of and $NH_4^+$ are (a) $sp$ , $sp^3$ and $sp^2$ respectively (b) $sp$ , $sp^2$ and $sp^3$ respectively (c) $sp^2$ , $sp$ and $sp^3$ respectively (d) $sp^2$ , $sp^3$ and $sp$ respectively	S nitrogen in $NO_2^+$ , $NO_3^-$ , [IIT Screening 2000]	30.	molecule in ice is [M (a) 4 (c) 2 Hydrogen bonding is not (a) Glycerine (b) Water (c) Hydrogen sulphide	P PET 1993; AI (b) (d) present in	PMC 2002;UPSEA 3 1 [AIIMS 1998; MI	T 1999, 2001, 02] P PET/PMT 1998]
24.	The molecule having one unpaired elect         (a) NO       (b)         (c) CN <sup>-</sup> (d)	ron is [ <b>11T 1985; MP PMT 1989</b> ] <i>CO</i> <i>O</i> <sub>2</sub>	31.	(a) Hydrogen fluoride The bonds in $K_4$ [Fe(Ca (a) All ionic (b) All covalent (c) Ionic and covalent	N) <sub>6</sub> ] are		[EAMCET 1991]
25.	The geometry of $ClO_3^-$ , according to repulsion (VSEPR) theory will be (a) Planar triangle (b) 1 (c) Tetrahedral (d) 9 Which of the following belogges has the	o valence shell electron pair [ <b>KCET 1996; MP PET 1997</b> ] Pyramidal Square planar	32.	<ul> <li>(c) Ionic and covalent</li> <li>(d) Ionic, covalent and c</li> <li>In which of the following present</li> <li>(a) Water</li> <li>(b) Ammonia</li> </ul>	oordinate cov g ionic, coval	/alent ent and coordi	nate bonds are [UPSEAT 2002]
26.	(a) $F_2$ (b) (c) $Br_2$ (d)	Cl <sub>2</sub>	5	<ul> <li>(c) Sodium cyanide</li> <li>(d) Potassium bromide</li> </ul>			
27.	What bond order does $O_2^{2-}$ have	[Pb. PMT 2007]					
		Answers	anc	Solutions			
							SET -3)
1. 2.	<ul> <li>(b) If the two elements have similar between them will be covalent, electronegativities leads to an ionic</li> <li>(a) From electronic configuration vale <ul> <li>I respectively so formula of comp</li> </ul> </li> </ul>	electronegativities, the bond while a large difference in bond. encies of $X$ and $Y$ are + 2 and ound is $XY_2$ .	3. 4. 5.	<ul> <li>(b) lonic compounds cather they don't have mob</li> <li>(d) AlCl<sub>3</sub> sublimes read</li> <li>(c) Structure of KCN is</li> </ul>	an't pass electric for a solution of the solution in solution in the solution of the solution	ctricity in solic d state. ng. /)].	l state because

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6. Sugar is an organic compound which is covalently bonded so in (b) water it remains as free molecules. . 2

7. (c) In the reaction 
$$BaO_2 + H_2SO_4 \rightarrow BaSO_4 + H_2O$$
 valency is not changing.

- 8. (d)  $BF_3$  does not have octet, it has only six electrons so it is electron deficient compound.
- (b) NaCl is a ionic compound because it consists of more 9. elelctronegativity difference compare to HCl.
- $NH_4Cl$  has a coordinate bond besides covalent and ionic 10. (a)

7+

bonds 
$$\begin{bmatrix} H \\ H \\ H \\ -N \\ H \end{bmatrix}^{+} Cl^{-}$$

- $^{-}O C = O$  has covalent bonds only. 11. (b)
- Due to symmetry dipole moment of *p*-dichloro benzene is zero. 12. (b) 13. (d)
- CCl<sub>4</sub> has zero dipole moment because of symmetric (d) 14 tetrahedral structure.  $CH_3Cl$  has slightly higher dipole moment which is equal to 1.86*D*. Now  $CH_3Cl$  has less electronegativity then  $CH_2Cl_2$ . But  $CH_2Cl_2$  has greater dipole moment than  $CHCl_3$ .
- More the difference in electronegativity of atoms. Bond 15. (a) between them will be more polar.
- C-F bond has the most polar character due to difference of 16. (d) their electronegativity.
- $H_2S$  has angular geometry and have some value of dipole 17. (a) moment.

(a) 
$$N \sigma = C \qquad \sigma C = \sigma C \qquad \sigma$$

 $9\pi$  and  $9\sigma$  bonds.

18.

- (d)  $H_3O^+$  has  $sp^3$  hybridization and its shape is triangular 19. pyramidal due to lone pair on oxygen.
- $SO_2$  molecule has  $sp^2$  hybridisation. 20. (c) C
- (b) ln |||  $\dot{C}a$  two carbons are joined with  $1\sigma$  and  $2\pi$  bonds. 21. c
- (a) In  $N_2O$  molecule  $N \equiv N O$  structure is most contributed. 22.
- (b) The shape of  $NO_2^+$ ,  $NO_3^-$  and  $NH_4^+$  are linear trigonal 23. planar and tetrahedral respectively. Thus the hybridization of atomic orbitals of nitrogen in these species are  $sp, sp^2$  and  $sp^3$  respectively.
- NO has one unpaired electron with Nitrogen. (a) 24

**25.** (b) 
$${}^{-}O - Cl - O$$

(b) Bond energy of  $Cl_2$  is highest among all halogen molecule. 26. Bond energies of  $F_2$ ,  $Cl_2$ ,  $Br_2$ ,  $I_2$  are 37, 58, 46 and 36 Kcal  $mol^{-1}$  respectively.

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27.  $O_2^{2-}$  have bond order one (c)

B.O. 
$$=\frac{1}{2}[10-8]=\frac{2}{2}=1$$
.

- (b) Electron lost from antibonding  $\pi$  orbital.
- 28. In ice each water molecule forms four hydrogen bond through 29. (a) which each water molecule is tetrahedrally attached with other water molecule.



- 30. Hydrogen bonding is present in molecules which have F, O, or (c) N atoms.
- Structure of  $K_4[Fe(CN)_6]$  is 31. (d)



(c) Sodium cyanide contain ionic, covalent and coordinate bond.

32.