CHEMICAL BONDING

01 VSEPR

2,0-	Linear - 180°
3,0-	Trigonal planar - 120 °
2,1-	Bent shape
4,0-	Tetrahedral - 109°28'
3,1-	Pyramidal - 107°
2,2-	Bent - 104.5°
5,0-	Trigonal Bipyramidal
4,1-	See saw
3,2-	T-shape
2,3-	Linear - 180°
6,0-	Octahedral - 90°
5,1-	Square pyramidal
4,2-	Square planar
7,0-	Pentagonal bipyramidal
6,1-	Distorted octahedral

Q1 In which of the following pairs are the two species trigonal pyramidal ?

1) BrO_3^- and XeO_3 2) SF_4 and XeF_4
2) SO_3^{2-} and NO_3^- 4) BF_3 and NF_3

02

$$EP = \frac{CVE + \text{no. of MV}}{2}$$

MV → BP, Remaining → LP : Monoatomic surrounding atoms

$$EP = \frac{CVE + 0}{2}$$

DV → BP, Remaining → LP : Diatomic surrounding atoms

$$EP = \frac{CVE + \text{negative charge} - \text{positive charge}}{2}$$

MV/DV → BP, Remaining → LP : Charged Compound

LP-LP > LP-BP > BP-BP (Repulsion)

Q2 Total no. of Lone pairs in I_3^- is

1) 3 2) 6
3) 9 4) 12

03 HYBRIDISATION

2- sp - Linear
3- sp^2 - Trigonal planar
4- sp^3 - Tetrahedral
5- sp^3d - Trigonal pyramidal
6- sp^3d^2 - Octahedral
7- sp^3d^3 - Pentagonal bipyramidal

CH_3-CH_3 - sp^3
$CH_2=CH_2$ - sp^2
$CH\equiv CH$ - sp
$=C=$ - sp

Q3 In XeF_6, oxidation state and state of hybridisation of Xe and shape of the molecule are, respectively

1) +6, sp^3d^3 , distorted octahedral
2) +4, sp^3d^2 , square planar
3) +6, sp^3 , pyramidal
4) +6, sp^3d^2 square pyramidal

04

VALENCE BOND THEORY

$C - C$ = 1σ bond
$C = C$ = 1σ + 1π
$C \equiv C$ = 1σ + 2π

MOLECULAR ORBITAL THEORY

Up to N_2 the energy order is,
$\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < (\pi 2p_x = \pi 2p_y) < \sigma 2p_z < (\pi^* 2p_x = \pi^* 2p_y) < \sigma^* 2p_z$

After N_2 the energy order is,(for O_2, F_2, Ne_2)
$\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < \sigma 2p_z < (\pi 2p_x = \pi 2p_y) < (\pi^* 2p_x = \pi^* 2p_y) < \sigma^* 2p_z$

B_2-10 Paramagnetic $\pi 2p_x^1 = \pi 2p_y^1$
O_2-16 Paramagnetic $\pi^* 2p_x^1 = \pi^* 2p_y^1$

Q4 The no. of unpaired electrons in O_2 molecule is:

1) 0 2) 1
3) 2 4) 3

05 BOND ORDER

Total no.of e⁻

2 - 1 - Diamagnetic
3 - 0.5 - Paramagnetic
4 - 0 - Diamagnetic
5 - 0.5 - Paramagnetic
6 - 1 - Diamagnetic
7- 0.5- Paramagnetic
8 - 0 - Diamagnetic
9 - 0.5 - Paramagnetic
10 - 1 - Paramagnetic
11 - 1.5 - Paramagnetic
12 - 2 - Diamagnetic
13 - 2.5 - Paramagnetic
14 - 3 - Diamagnetic
15 - 2.5 - Paramagnetic
16 - 2 - Paramagnetic
17 - 1.5 - Paramagnetic
18 - 1 - Diamagnetic
19 - 0.5 - Paramagnetic
20 - 0 - Diamagnetic

Odd number + 10&16 - Paramagnetic
Even number except 10&16 - Diamagnetic

BOND PARAMETERS

BOND ORDER

$B.O \propto \frac{1}{B.L} \propto$ Stability $\propto$ Bond strength

$B.O\text{-}O_2^{2+} > O_2^+ > O_2$

$B.L\text{-}O_2 > O_2^+ > O_2^{2+}$

BOND ENERGY

1) Hybridisation
sp> sp^2 >sp^3
2) B.E.∝ B.O. (No. of Bonds)
N_2> O_2 >F_2
3) B.E. ∝E.N. difference
HF> HCl > HBr > HI
4) Halogens (B.E.)
Cl_2> Br_2 > F_2 > I_2

DIPOLE MOMENT (μ)

1) Polar molecule, μ ≠ 0
Irregular geometry.
a) Different bonds
b) Lone pairs
c) Different surrounding atoms
eg: SF_4, CH_3Cl
2) Non polar molecule, μ =0
Regular geometry
a) Same bonds
b) Zero lone pairs
c) Same surrounding atoms
eg: CH_4, CO_2

$CH_3OH > CH_3Cl > H_2O > NH_3 > NF_3 > BF_3$ (μ=0)

RESONANCE

Resonance Changes B.O.

1) Benzene

$= \frac{3}{2} = 1.5$

B.L.: $C_2H_6 > C_6H_6 > C_2H_4 > C_2H_2$
B.O.: 1 1.5 2 3

2) O_3 $= \frac{3}{2} = 1.5$

B.L.: $H_2O_2 > O_3 > O_2$
B.O.: 1 1.5 2

BOND ANGLE

1) Max B.A-180°[sp]
2) Hybridisation
sp > sp^2 > sp^3
NO_2^+ > NO_2 > NO_2^-
sp sp^2
3) if LP↑ B.A↓
CH_4 > NH_3 > H_2O [sp^3]
0 LP 1 LP 2 LP
4) If electronegativity of C.A ↑ B.A↑
NH_3 > PH_3 > AsH_3 > SbH_3
5) If electronegativity oF S.A↑ B.A↓
NI_3> NBr_3> NCl_3> NF_3

BOND LENGTH

1) B.L ↑with Size of atom
HI > HBr > HCl > HF
2) B.L decreases with multiplicity
C-C>C=C>C≡C

Q5 Which of the following molecules has the maximum bond enthalpy?

1) N_2 2) CO
3) F_2 4) HF

Q6 Which of the following will have maximum dipole moment?

1) NF_3 2) NH_3
3) CH_4 4) PCl_3

Q7 The correct order in which the O-O bond length decreases in the following is

1) $O_3 > H_2O_2 > O_2$ 2) $O_2 > O_3 > H_2O_2$
3) $O_2 > H_2O_2 > O_3$ 4) $H_2O_2 > O_3 > O_2$

Q8 The correct order of bond angle is:

1) $H_2O > NH_3 > CH_4 > CO_2$
2) $H_2O < NH_3 < CO_2 > CH_4$
3) $H_2O < NH_3 < CO_2 > CH_4$
4) $CO_2 > CH_4 > NH_3 > H_2O$

Q9 The correct order of increasing bond length of C-H,C-O,C-C & C=C is:

1) C-C < C=C < C-O < C-H
2) C-O < C-H < C-C < C=C
3) C-H < C-O < C-C < C=C
4) C-H < C=C < C-O < C-C

Hydrogen bond- Formation of bond between hydrogen & most electronegetive elements like F,O,N

Intramolecular - H – Bonding occur within one single molecule.

Intermolecular - H Bonding between two different molecules of same or different compounds.

Intramolecular H bonding increases the boiling point. eg: Intermolecular H bond in p-nitrophenol increases the boiling point. HF(HB) > HI > HBr > HCl. H_2O(4HB) > H_2Te > H_2Se > H_2S

Fajan's Rule - Indicates Covalent character in an ionic bond.

1) Size of the cation- Smaller the cation higher is the polarisation, so covalent character increases
LiCl > NaCl > KCl > RbCl > CsCl
2) Size of anion- As the size of anion increases, polarisation increases, covalent character increases
AgF < AgCl < AgBr < AgI
3) Charge on the cation- As the charge increases, Covalent character also increases
LiCl < $BeCl_2$ < BCl_3 < CCl_4