

0.1

## 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

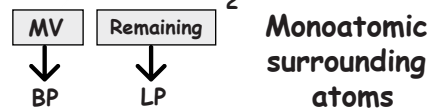
Q1

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

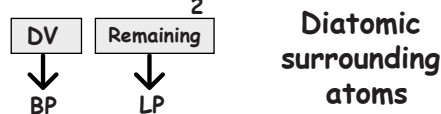
- 1)  $\text{BrO}_3^-$  and  $\text{XeO}_3$  2)  $\text{SF}_4$  and  $\text{XeF}_4$   
 2)  $\text{SO}_3^{2-}$  and  $\text{NO}_3^-$  4)  $\text{BF}_3$  and  $\text{NF}_3$

0.2

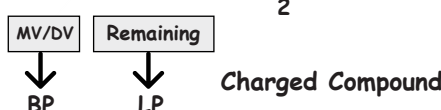
$$\text{EP} = \frac{\text{CVE} + \text{no. of MV}}{2}$$



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



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



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

Q2

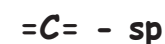
Total no. of Lone pairs in  $\text{I}_3^-$  is

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

0.3

## HYBRIDISATION

- 2-  $\text{sp}$  - Linear  
 3-  $\text{sp}^2$  - Trigonal planar  
 4-  $\text{sp}^3$  - Tetrahedral  
 5-  $\text{sp}^3\text{d}$  - Trigonal pyramidal  
 6-  $\text{sp}^3\text{d}^2$  - Octahedral  
 7-  $\text{sp}^3\text{d}^3$  - Pentagonal bipyramidal



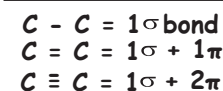
Q3

In  $\text{XeF}_6$ , oxidation state and state of hybridisation of Xe and shape of the molecule are, respectively

- 1) +6,  $\text{sp}^3\text{d}^3$ , distorted octahedral  
 2) +4,  $\text{sp}^3\text{d}^2$ , square planar  
 3) +6,  $\text{sp}^3$ , pyramidal  
 4) +6,  $\text{sp}^3\text{d}^2$ , square pyramidal

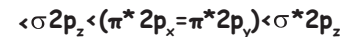
0.4

## VALENCE BOND THEORY

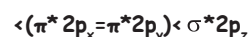
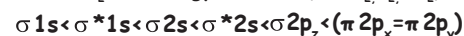


## MOLECULAR ORBITAL THEORY

Up to  $\text{N}_2$  the energy order is,



After  $\text{N}_2$  the energy order is, (for  $\text{O}_2, \text{F}_2, \text{Ne}_2$ )



Q4

The no. of unpaired electrons in  $\text{O}_2$  molecule is:

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

0.5

## BOND ORDER

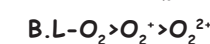
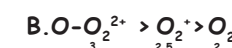
Total no. of e <sup>-</sup>	2 - 1 - Diamagnetic
	3 - 0.5 - Paramagnetic
	4 - 0 - Diamagnetic
	5 - 0.5 - Paramagnetic
	6 - 1 - Diamagnetic
	7 - 0.5 - Paramagnetic
	8 - 0 - Diamagnetic
	9 - 0.5 - Paramagnetic
	10 - 1 - Paramagnetic
	11 - 1.5 - Paramagnetic
	12 - 2 - Diamagnetic
	13 - 2.5 - Paramagnetic
	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

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



## CHEMICAL BONDING



## BOND ENERGY

- 1) Hybridisation  
 $\text{sp} > \text{sp}^2 > \text{sp}^3$   
 2) B.E.  $\propto$  B.O. (No. of Bonds)  
 $\text{N}_2 > \text{O}_2 > \text{F}_2$   
 3) B.E.  $\propto$  E.N. difference  
 $\text{HF} > \text{HCl} > \text{HBr} > \text{HI}$   
 4) Halogens (B.E.)  
 $\text{Cl}_2 > \text{Br}_2 > \text{F}_2 > \text{I}_2$

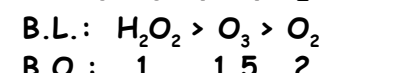
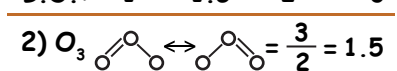
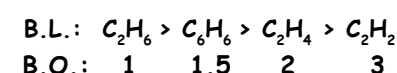
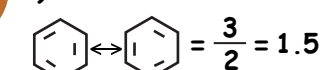
DIPOLE MOMENT ( $\mu$ )

- 1) Polar molecule,  $\mu \neq 0$   
 Irregular geometry.  
 a) Different bonds  
 b) Lone pairs  
 c) Different surrounding atoms  
 eg:  $\text{SF}_4$ ,  $\text{CH}_3\text{Cl}$   
 2) Non polar molecule,  $\mu = 0$   
 Regular geometry  
 a) Same bonds  
 b) Zero lone pairs  
 c) Same surrounding atoms  
 eg:  $\text{CH}_4$ ,  $\text{CO}_2$   
 $\text{CH}_3\text{OH} > \text{CH}_3\text{Cl} > \text{H}_2\text{O} > \text{NH}_3 > \text{NF}_3 > (\text{BF}_3)$   
 $\mu = 0$

## RESONANCE

Resonance Changes B.O.

1) Benzene



## BOND ANGLE

- 1) Max B.A - 180° [sp]  
 2) Hybridisation  
 $\text{sp} > \text{sp}^2 > \text{sp}^3$   
 $\text{NO}_2^+ > \text{NO}_2 > \text{NO}_2^-$   
 $\text{sp} \quad \text{sp}^2$   
 3) if LP  $\uparrow$  B.A  $\downarrow$   
 $\text{CH}_4 > \text{NH}_3 > \text{H}_2\text{O}$  [sp<sup>3</sup>]  
 0 LP 1 LP 2 LP  
 4) If electronegativity of C.A  $\uparrow$  B.A  $\uparrow$   
 $\text{NH}_3 > \text{PH}_3 > \text{AsH}_3 > \text{SbH}_3$   
 5) If electronegativity of S.A  $\uparrow$  B.A  $\downarrow$   
 $\text{NI}_3 > \text{NBr}_3 > \text{NCl}_3 > \text{NF}_3$

## BOND LENGTH

- 1) B.L  $\uparrow$  with Size of atom  
 $\text{HI} > \text{HBr} > \text{HCl} > \text{HF}$   
 2) B.L decreases with multiplicity  
 $\text{C}-\text{C} > \text{C}=\text{C} > \text{C}\equiv\text{C}$

Q5

Which of the following molecules has the maximum bond enthalpy?

- 1)  $\text{N}_2$  2)  $\text{CO}$   
 3)  $\text{F}_2$  4)  $\text{HF}$

Q6

Which of the following will have maximum dipole moment?

- 1)  $\text{NF}_3$  2)  $\text{NH}_3$   
 3)  $\text{CH}_4$  4)  $\text{PCl}_3$

Q7

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

- 1)  $\text{O}_3$  >  $\text{H}_2\text{O}_2$  >  $\text{O}_2$  2)  $\text{O}_2$  >  $\text{O}_3$  >  $\text{H}_2\text{O}_2$   
 3)  $\text{O}_2$  >  $\text{H}_2\text{O}_2$  >  $\text{O}_3$  4)  $\text{H}_2\text{O}_2$  >  $\text{O}_3$  >  $\text{O}_2$

Q8

The correct order of bond angle is:

- 1)  $\text{H}_2\text{O} > \text{NH}_3 > \text{CH}_4 > \text{CO}_2$   
 2)  $\text{H}_2\text{O} < \text{NH}_3 < \text{CO}_2 > \text{CH}_4$   
 3)  $\text{H}_2\text{O} < \text{NH}_3 > \text{CO}_2 > \text{CH}_4$   
 4)  $\text{CO}_2 > \text{CH}_4 > \text{NH}_3 > \text{H}_2\text{O}$

Q9

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

- 1)  $\text{C}-\text{C} < \text{C}=\text{C} < \text{C}-\text{O} < \text{C}-\text{H}$   
 2)  $\text{C}-\text{O} < \text{C}-\text{H} < \text{C}-\text{C} < \text{C}=\text{C}$   
 3)  $\text{C}-\text{H} < \text{C}-\text{O} < \text{C}-\text{C} < \text{C}=\text{C}$   
 4)  $\text{C}-\text{H} < \text{C}=\text{C} < \text{C}-\text{O} < \text{C}-\text{C}$

Hydrogen bond- Formation of bond between hydrogen & most electronegative 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.  $\text{HF}(\text{HB}) > \text{HI} > \text{HBr} > \text{HCl}$ .  $\text{H}_2\text{O}(4\text{HB}) > \text{H}_2\text{Te} > \text{H}_2\text{Se} > \text{H}_2\text{S}$

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  
 $\text{LiCl} > \text{NaCl} > \text{KCl} > \text{RbCl} > \text{CsCl}$   
 2) Size of anion- As the size of anion increases, polarisation increases, covalent character increases  
 $\text{AgF} < \text{AgCl} < \text{AgBr} < \text{AgI}$   
 3) Charge on the cation- As the charge increases, Covalent character also increases  
 $\text{LiCl} < \text{BeCl}_2 < \text{BCl}_3 < \text{CCl}_4$