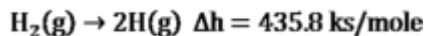


Chemical Bonding

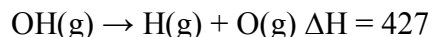
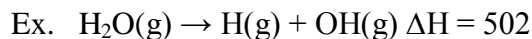
Day - 4

For a diatomic molecular Bond energy simply energy required to break the bond.



$$\text{so } (\text{BE})_{\text{H-H}} = 435.8 \text{ kJ/mole}$$

For Hetero-nuclear molecular it is average energy or mean energy.



$$\text{So } (\text{B. E})_{\text{H-O}} = \frac{502 + 427}{2} = 464.5 \text{ kJ/mole}$$

Bond length or bond distance is the average distance between nuclei of two bonded atoms in a molecule. It is a transferable property of a bond between atoms of fixed types, relatively independent of the rest of the molecule

$$\text{Bond Strength} \propto \frac{1}{\text{Bond length}}$$

1. Sigma bond (σ) > Pi (π) bond
2. Triple bond > double bond > single bond
3. s – s overlap > s – p overlap > p – p overlap

BOND ANGLE

It is defined as the angle between the orbitals containing bonding electron pairs around the central atom in a molecule/complex ion. Bond angle is always determined experimentally.

Ex.8: Which of the following statements is not correct? [NEET 1993]

- (a) Double bond is shorter than a single bond
- (b) Sigma bond is weaker than a π -bond
- (c) Double bond is stronger than a single bond
- (d) Covalent bond is stronger than H-H bond

Sigma bond is always stronger than π -bond because the extent of overlapping is maximum in sigma bond formation.

Answer (b)

Ex.9: Which one of the following is the correct order of interactions? [NEET 1993]

- (a) Covalent < hydrogen bonding < van der Waals' < dipole-dipole
- (b) Vander Waals' < hydrogen bonding < dipole-dipole < covalent
- (c) Vander Waals' < dipole-dipole < hydrogen bonding < covalent
- (d) Dipole-dipole < Vander Waals' < hydrogen bonding < covalent

The Vander Waals' forces are weakest forces and covalent bond is strongest, so the order of interactions is Vander Waals' < H-bonding < dipole-dipole < covalent.

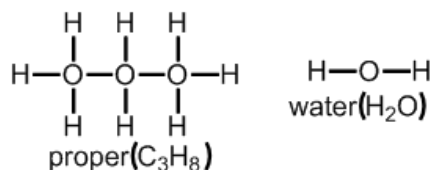
Answer (b)

BOND ENTHALPY

Chemical Bonding

It is defined as the amount of energy required to break one mole of bonds of a particular type between two atoms in a gaseous state.

LEWIS STRUCTURE



Lewis structure cannot explain the shape of molecule.

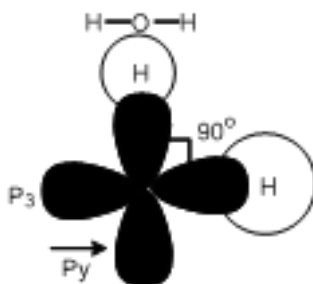
Shape of H_2O .

$\text{H} \rightarrow 1s^2$

$\text{O} \rightarrow 1s^2 2s^2 2p_x^2 2p_y^1 2p_z^1$

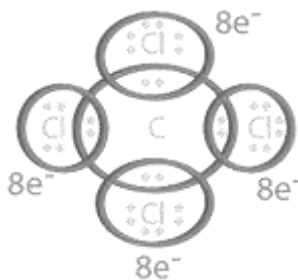
Angle $\text{H}-\text{O}-\text{H}$

Is 90° as per this model but shell $L = 104.5^\circ$



OCTET RULE

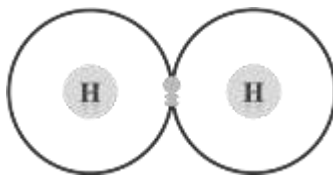
Kössel and Lewis in 1916 developed an important theory of chemical combination between atoms known as electronic theory of chemical bonding. According to this, atoms can combine either by transfer of valence electrons from one atom to another (gaining or losing) or by sharing of valence electrons in order to have an eight electrons in their valence shells.



Exceptions to the Octet Rule:

1. **Hydrogen molecule:** Hydrogen has one electron in its first energy shell ($n = 1$). It needs only one more electron to fill this shell, because the first shell cannot have more than two electrons. This configuration ($1s^2$) is similar to that of noble gas helium and is stable. In this case, therefore, octet is not needed to achieve a stable configuration

Chemical Bonding



Incomplete octet of the central atom: The octet rule cannot explain the formation of certain molecules of lithium, beryllium, boron, aluminium, etc. (LiCl , BeH_2 , BeCl_2 , BH_3 , BF_3) in which the central atom has less than eight electrons in the valence shell as shown below:



Expanded octet of the central atom: There are many stable molecules which have more than eight electrons in their valence shells. For example, PF_5 , has ten; SF_6 has twelve and IF_7 has fourteen electrons around the central atoms, P, S, and I respectively



Odd electron molecules: There are certain molecules which have odd number of electrons, like nitric oxide, NO and Nitrogen dioxide, NO_2 . In these cases, octet rule is not satisfied for all the atoms.



It may be noted that the octet rule is based upon the chemical inertness of noble gases. However, it has been found that some noble gases (especially xenon and krypton) also combine with oxygen and fluorine to form a large number of compounds such as XeF_2 , KrF_2 , XeOF_2 , XeOF_4 , XeF_6 , etc.

This theory does not account for the shape of the molecules. It cannot explain the relative stability of the molecule in terms of the energy.

HYBRIDISATION AND SHAPE

Salient features of hybridisation: The main features of hybridisation are as under:

1. The number of hybrid orbitals is equal to the number of the atomic orbitals that get hybridised.
2. The hybridised orbitals are always equivalent in energy and shape
3. The hybrid orbitals are more effective in forming stable bonds than the pure atomic orbitals.
4. These hybrid orbitals are directed in space in some preferred direction to have minimum repulsion between electron pairs and thus a stable arrangement.

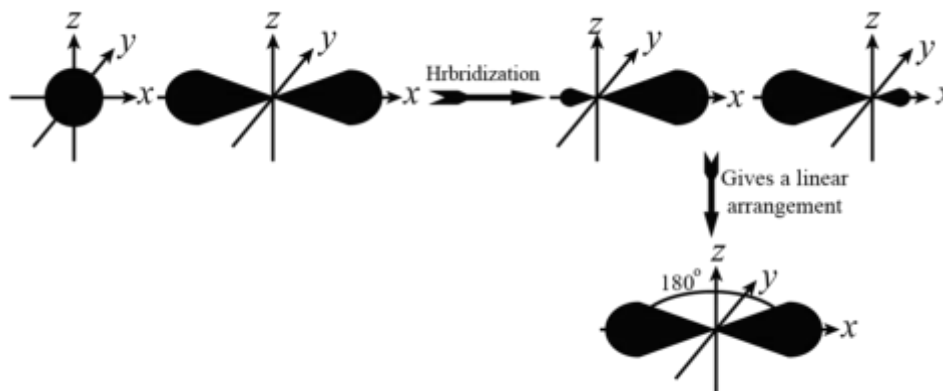
Therefore, the type of hybridisation indicates the geometry of the molecules

Chemical Bonding

Important conditions for hybridisation

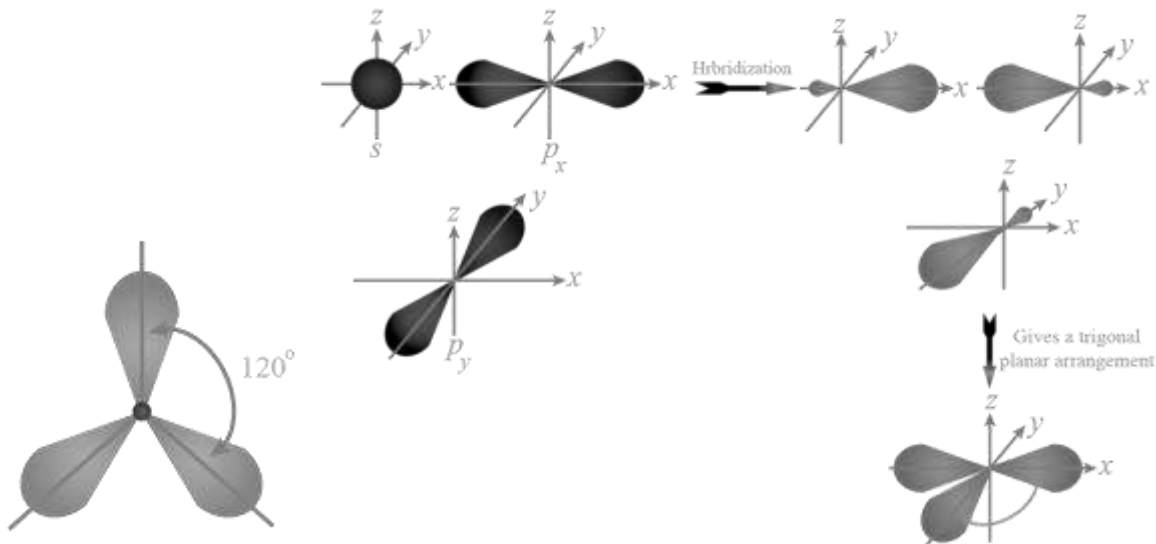
- (i) The orbitals present in the valence shell of the atom are hybridised.
- (ii) The orbitals undergoing hybridisation should have almost equal energy.
- (iii) Promotion of electron is not essential condition prior to hybridisation.
- (iv) It is not necessary that only half filled orbitals participate in hybridisation. In some cases, even filled orbitals of valence shell take part in hybridisation

(i) sp HYBRIDISATION:



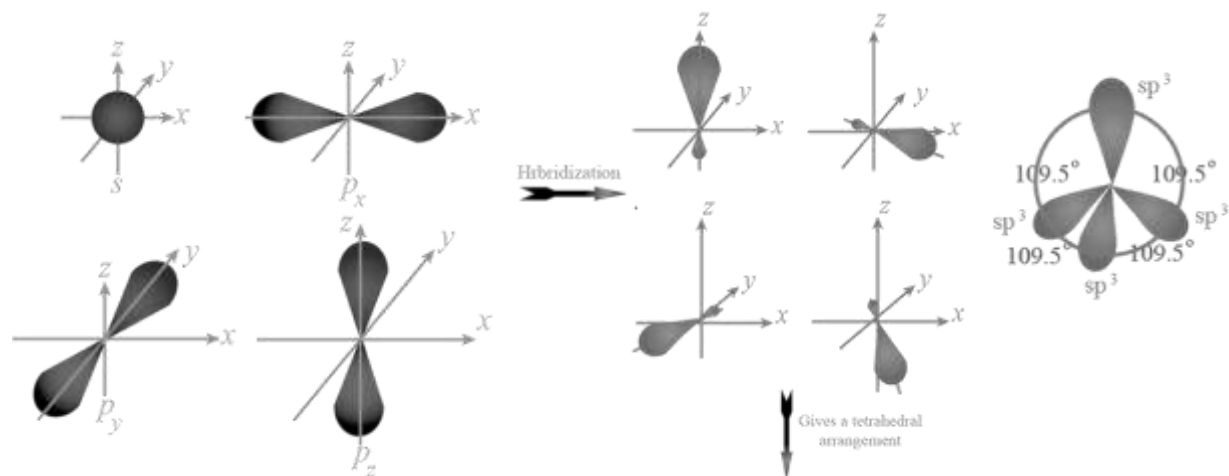
(II) sp²

HYBRIDISATION:

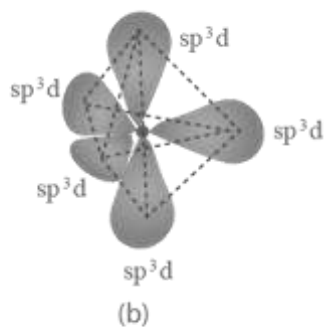


(iii) sp³ HYBRIDISATION

Chemical Bonding



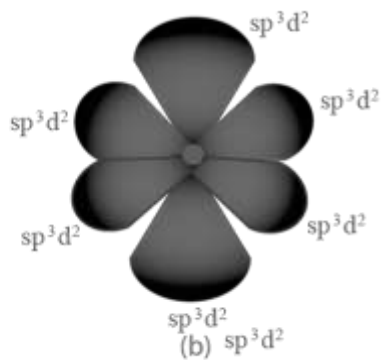
(a)



sp³d hybridisation



(a)



sp³d² hybridisation

Question Practice Online