ORGANIC CHEMISTRY – SOME BASIC PRINCIPLES

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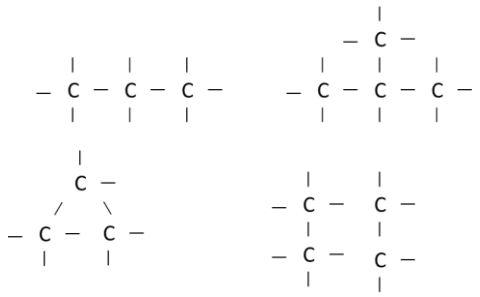
Organic Chemistry is a branch of Chemistry which deals with the study of organic compounds i.e. hydrocarbons and their derivatives. All organic compounds contain carbon as their essential constituent. In fact, organic chemistry is, now-a-days, defined as the chemistry of carbon compounds.

Reasons for having so many compounds of carbon are as under :–

1. **Tendency of Carbon Atom:** The atomic number of carbon is 6 and it has 4 electrons in its valence shell. In order to acquire a stable noble gas configuration it can share its electrons with the electrons of other atoms to form four covalent bonds.
2. **Electronegativity of Carbon:** The tendency of carbon atom to form covalent bod is justified on the basis of its electronegativity value which is 2.5 close to the value of other atoms with which carbon is generally linked in carbon compound, viz. H(2.2), N(3.0), O(3.5), Cl(3.0), S(2.5), P(2.1) etc.
3. **Catenation:** Carbon atom has a unique property to form bonds with other carbon atoms. This property of forming bonds with atoms of the same element is called catenation. Carbon shows maximum catenation in the periodic table and as a result, it can form a large variety of structures such as linear chains of different lengths, branched chain and ring of different sizes.

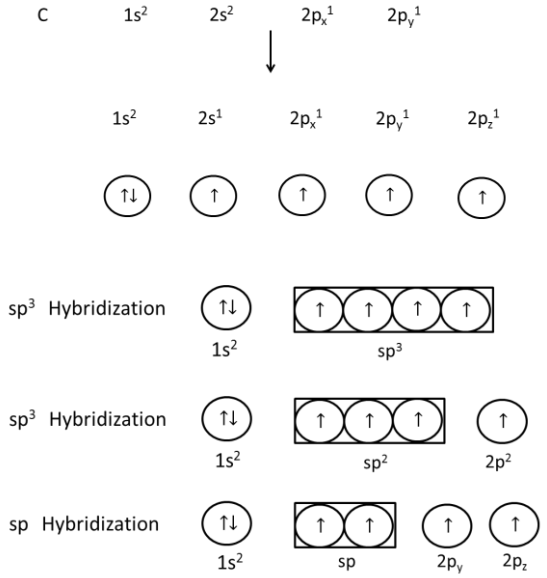


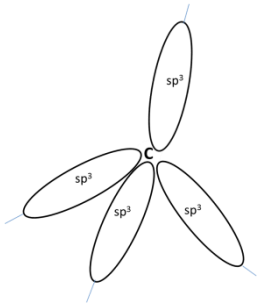
Maximum catenation is due to larger bond strength of carbon to carbon as compared to that of other atoms.

4. **Tendency to Make Multiple Bonds:** Due to small size, carbon can make overlapping and also can make multiple bonding with itself or oxygen or nitrogen**.**

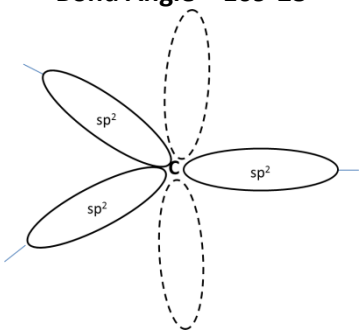
HYBRIDIZATION IN CARBON COMPOUNDS: Hybridization is the phenomenon of intermixing of orbitals of slightly different energies so as to redistribute their energies and to give a new set of orbitals of equivalent energies and shape. The new orbitals formed as a result of hybridization are called hybrid orbitals.

Carbon does not use simple s- and p- orbitals for bonding but it mixes s- and p- orbitals to form hybrid orbitals which have shape and properties in between s- and p- orbitals. Carbon exhibits three types of hybridization depending upon the mixing of one s-electron with one, two or three p-orbitals as shown below –

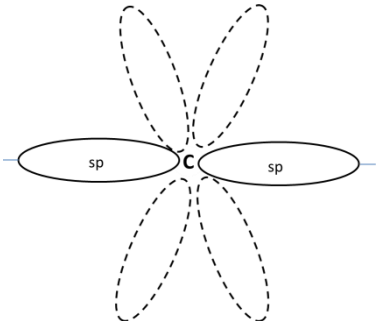




sp^3 orbital: Shape – Rectangular-tetrahedral; Bond Angle = $109^0 28'$



sp^2 orbital: Shape Equilateral Triangle; Bond Angle = 120^0

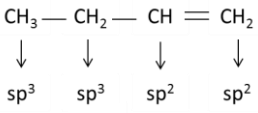


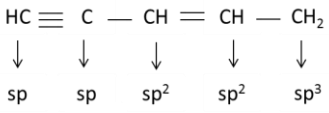
sp orbital: Shape – Linear Arrangement; Bond Angle = 180^0

The hybrid orbitals can overlap with atomic orbitals of other atoms to form σ-bonds.

Example – in CH_4 the four sp_3 hybrid orbitals overlap with 1s orbitals of four hydrogen atoms to form four σ-bonds having tetrahedral geometry. The un-hybridized p-orbitals can overlap sidewise to form r-bonds.

- For predicting the type of hybridization of a carbon atom in organic compound, calculate the number of σ-bonds which it forms (π-bonds are excluded from hybridization.
- The number of orbitals hybridized will be same as the number of σ-bonds. Out of these one will be S-orbital (always) and others will be p-orbitals.
- If it forms two σ-bonds the hybridization will be sp, if it forms three σ-bonds, the hybridization will be sp^2 and so on.





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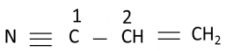
ASSIGNMENT

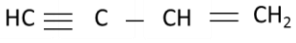
Select the Correct Answer

1. Which out of the following types of hybridization leads to a trigonal geometry.
   (A) sp (B) sp^2 (C) sp^3 (D) None of these

2. Maximum catenation of carbon tendency is due to –
   (A) Its tetravalency
   (B) Larger strength of carbon to carbon bond as compared to that of other atoms
   (C) Its electronegativity value close to other atoms (H, N, O, S) with which it forms bonds.
   (D) Its tendency to form multiple bonds.

3. Which of the following statement is not correct regarding sp hybridization of carbon?
   A) It is shown by compounds with –C Ξ C- bond
   (B) It leads to the formation of two hybridised and two unhybridized orbitals of carbon.
   (C) It results in tetrahedral geometry
   (D) The bond angle in compounds containing sp hybrid orbitals id 180^0

4. The bond between carbon atoms 1 and 2 in the compound  involves the hybridized carbon as -
   (A) sp^3 and sp^3 (B) sp^2 and sp^3 (C) sp and sp^2 (D) sp^3 and sp

5. The hybridization of carbon atom in –C-C- single bond of  is
   (A) sp^3, sp^3 (B) sp^2, sp^2 (C) sp, sp^2, (D) sp^3,sp

Answers to the ASSIGNMENT:

1.B (sp^2)**; 2.** B (larger strength of carbon to carbon bond as compared to that of other atoms)

3. C (It results in tetrahedral geometry); **4.** C (sp and sp^2); **5.**C (sp and sp^2).

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Author is M.Sc. (Chem.), M.Ed. and Advanced Diploma in German Language (Gold Medallist). She retired as a Principal, Govt. School Haryana, has 3-1/2 years' experience in teaching Chemistry and distance teaching through lectures on Radio and Videos. She has volunteered to complement mentoring of students for Chemistry through Online Web-enabled Classes of this initiative.

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