MAHESH PUBLIC SCHOOL

Class 11

BASIC CONCEPTS OF ORGANIC CHEMISTRY

SESSION 2020–21

Carbon is an essential element of organic compounds, it has four electrons in its outer most shell.

According to the ground state electronic configuration of carbon, it is divalent. Tetravalency of carbon can be explained by promoting one of the $2s^2$ - electrons to the unocupied $2p_z^1$ atomic orbital.

The four valencies of carbon atom are similar and they are symmetrically arranged around the carbon atom. According to **Le Bell and Van't Hoff** the four valencies of carbon do not lie in one plane. They are directed towards the corners of a regular tetrahedron with carbon atom at the centre and the angle between any two valencies is $109^{\circ}28'$.

Hybridisation in Organic Compounds

(1) The process of mixing atomic orbitals to form a set of new equivalent orbitals is termed as ***hybridisation***. There are *three types* of hybridisation,

(i) sp^3 ***hybridisation*** (involved in saturated organic compounds containing only single covalent bonds),

(ii) sp^2 ***hybridisation*** (involved in organic compounds having carbon atoms linked by double bonds) and

(iii) sp ***hybridisation*** (involved in organic compounds having carbon atoms linked by a triple bonds).

Table : 23.1

Type of hybridisation	sp^3	sp^2	sp
Number of orbitals used	1*s* and 3*p*	1*s* and 2*p*	1*s* and 1*p*
Number of unused *p*-orbitals	Nil	One	Two
Bond	Four -σ	Three -σ One -π	Two -σ Two -π
Bond angle	109.5°	120°	180°
Geometry	Tetrahedral	Trigonal planar	Linear
% *s*-character	25 or 1/4	33.33 or 1/3	50 or 1/2

(2) **Determination of hybridisation at different carbon atoms :** It can be done by two methods,

(i) ***First method*** : In this method hybridisation can be know by the number of $\pi-$ bonds present on that particular atom.

Number of $\pi-$ bond/s	0	1	2
Type of hybridisation	sp^3	sp^2	sp

Examples :

(i) $\underset{sp^3}{\underset{\downarrow}{CH_3}} - \underset{sp^2}{\underset{\downarrow}{CH}} = \underset{sp^2}{\underset{\downarrow}{CH}} - \underset{sp^2}{\underset{\downarrow}{\overset{\overset{O}{||}}{C}}} - \underset{sp^3}{\underset{\downarrow}{CH_3}}$

(ii) $\underset{sp^2}{\underset{\downarrow}{CH_2}} = \underset{sp}{\underset{\downarrow}{C}} = \underset{sp^2}{\underset{\downarrow}{CH_2}}$

(iii) $\underset{sp^3}{\underset{\downarrow}{CH_3}} - \underset{sp^2}{\underset{\downarrow}{CH}} = \underset{sp^2}{\underset{\downarrow}{CH}} - \underset{sp^3}{\underset{\downarrow}{CH_2}} - \underset{sp}{\underset{\downarrow}{C}} \equiv \underset{sp}{\underset{\downarrow}{N}}$

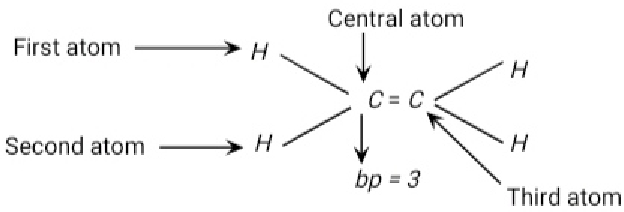
(iv) $\underset{sp}{\underset{\downarrow}{HC}} \equiv \underset{sp}{\underset{\downarrow}{C}} - \underset{sp^2}{\underset{\downarrow}{CH}} = \underset{sp^2}{\underset{\downarrow}{CH_2}}$

❑ In diamond carbon is sp^3 hybridised and in graphite carbon is sp^2 hybridised.

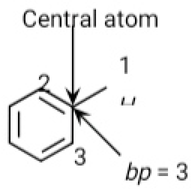
(ii) ***Second method*** : (Electron pair method)

$ep = bp + lp$; where ep = electron pair present in hybrid orbitals , bp = bond pair present in hybrid orbitals

Number of bp = Number of atoms attached to the central atom of the species



$$\overset{1}{H} - C \equiv \overset{2}{C} - H$$
$$\downarrow$$
$$bp = 2$$



Number of lp's can be determined as follows,

(a) If carbon has π - bonds or positive charge or odd electron, than lp on carbon will be zero.

(b) If carbon has negative charge, then lp will be equal to one.

Number of electron pairs (ep) tells us the type of hybridisation as follows,

ep	2	3	4	5	6
Type of hybridisation	sp	sp^2	sp^3	sp^3d	sp^3d^2

Example :

(i) $CH_2 = \overset{\oplus}{C}H$

$bp = 2$
$lp = 0$
$ep = 2,\ sp$

(ii) $CH_2 = \overset{\ominus}{C}H$

$bp = 2$
$lp = 1$
$ep = 3,\ sp^2$

(iii) $CH_2 = \overset{\bullet}{C} - CH_3$ with CH_3 on the central C

$bp = 3$
$lp = 0$
$ep = 3,\ sp^2$

(iv) $CH \equiv \overset{\ominus}{C}$

$bp = 1$
$lp = 1$
$ep = 2,\ sp$

(v) $CH_3 - \overset{\ominus}{C}H - CH_3$

$bp = 3$
$lp = 1$
$ep = 4,\ sp^3$