CHAPTER – 4

CARBON AND ITS COMPOUNDS

Carbon is a versatile element.

In earth's crust, carbon is 0.02% and found in form of minerals.

Atmosphere has 0.03% of Carbon dioxide.

All living structures are carbon based.

Covalent Bond in Carbon

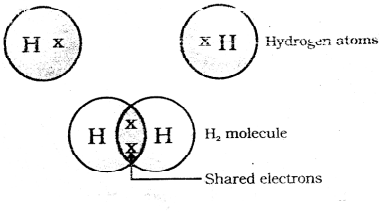
– The atomic number of carbon is 6 and its electronic configuration is 2, 4. To attain a noble gas configuration it can

1. Gain 4 electrons. But it would be difficult for nucleus to hold 4 extra electrons.
2. Lose 4 electrons. But it would require a large amount of energy to remove 4 electrons.

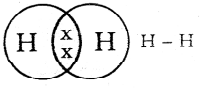
– It is difficult thus for an atom of carbon to either gain or lose electrons.

– Carbon attains the noble gas configuration by sharing its valence electrons with other atoms. Atoms of other elements like hydrogen, oxygen, nitrogen, chlorine also show sharing of valence electrons.

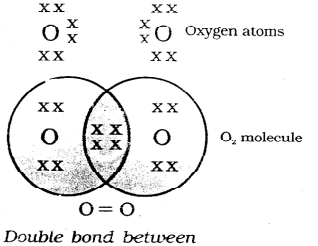
– Formation of H_2, O_2 and N_2 is shown as below :



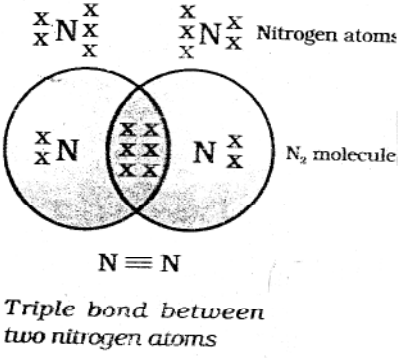
A molecule of hydrogen



Single bond between two hydrogen atoms



Double bond between two oxygen atoms



– It is evident that the number of shared pair of electrons can be one, two or three. Try making the structures of H_2O and CH_4.

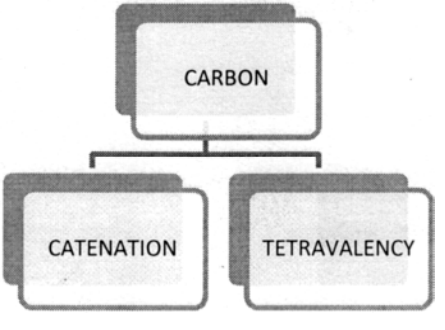
– Bond formed by the sharing of an electron pair between two atoms is called covalent bond.

– Covalently bonded molecules have low melting and boiling points because of comparatively weaker intermolecular forces, unlike ionic compounds.

– These molecules are generally poor conductor of electricity since no charged particles are formed.

Versatile Nature of Carbon Atoms:

Two important properties of carbon atom enable carbon to form enormously large number of compounds.

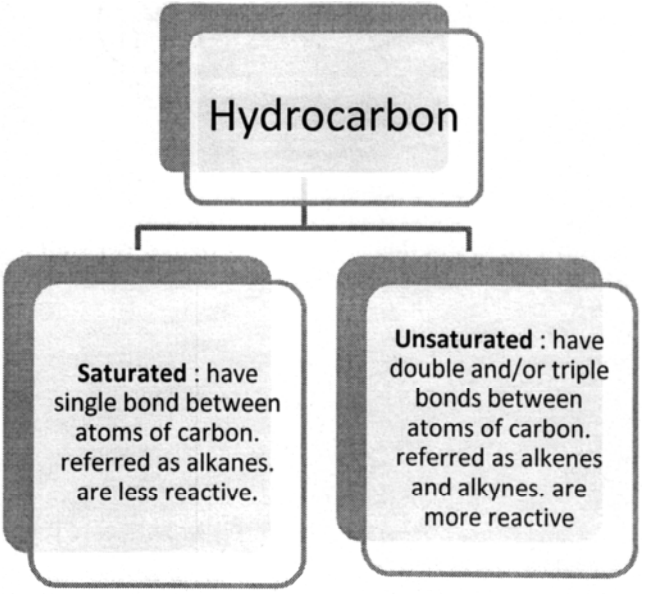


CATENATION : property of carbon atom to form bond with other atoms of carbon is called catenation. Like carbon, silicon forms compounds with hydrogen upto seven or eight atoms of silicon.

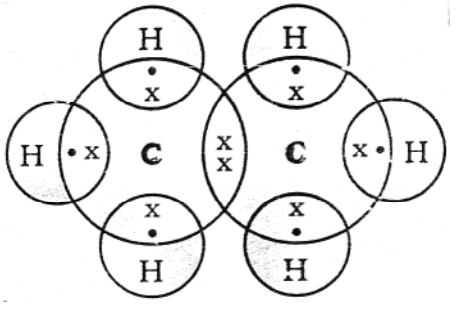
TETRAVALENCY : Having a valency of 4, carbon atom is capable of bonding with atoms of oxygen, hydrogen, nitrogen, sulphur, chlorine and other elements.

The smaller size of carbon atom enables nucles nucleus to hold the shared pair of electrons strongly, thus carbon compounds are very stable in general.

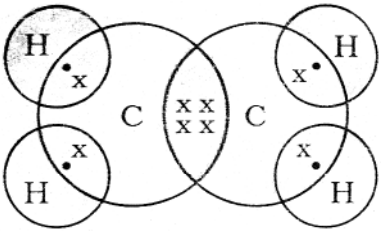
Saturated and Unsaturated Carbon Compounds



- ALKANE : $\mathbf{C_nH_{2n+2}}$
- ALKENE : $\mathbf{C_nH_2n}$
- ALKYNE : $\mathbf{C_nH_{2n-2}}$
- Electron dot structure of a saturated carbon compound, ethane is as follows:

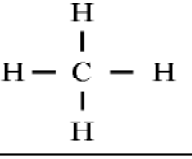
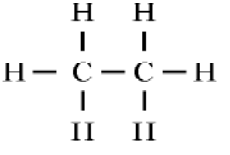
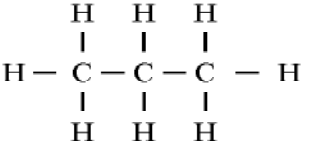
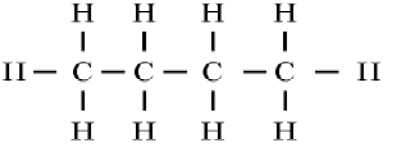
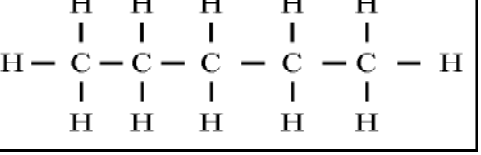


– Electron dot structure of an unsaturated cabon compound, ethene is as follows:

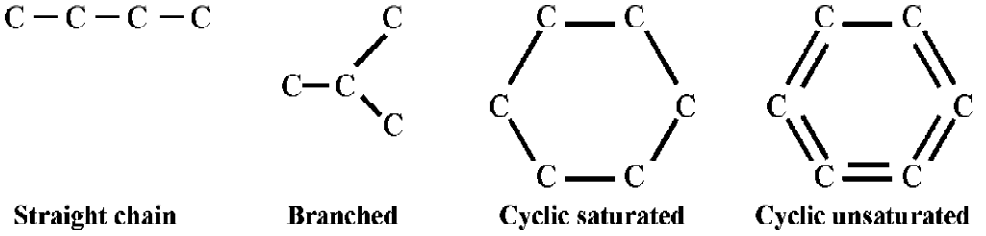


TRY DRAWING THE ELECTRON DOT STRUCTURE OF ETHYNE

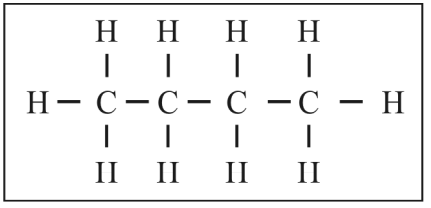
Formulae and Structures of Saturated Compounds of Carbon and Hydrogen

No. of Carbon Atoms	Name	Formula	Structure
1	Methane	CH_4	
2	Ethane	C_2H_6	
3	Propane	C_3H_8	
4	Butane	C_4H_{10}	
5	Pentane	C_5H_{12}	

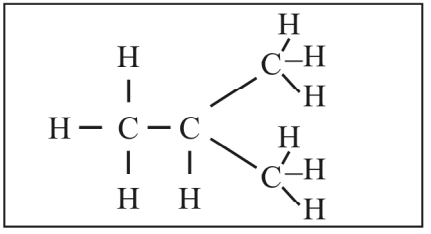
On the basis of structures the hydrocarbons can be:



Structural isomers : these are the compounds having identical molecular formula but different structures. For example, isomers of butane.



Straight Chain Isomer

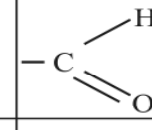
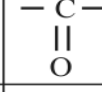
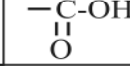


Branched Isomer of Butane

Heteroatom and Functional Group :

*In hydrocarbon chain, one or more hydrogen atoms can be replaced by other atoms in accordance with their valencies. The element that replaces hydrogen is called a heteroatom.

*These heteroatoms and the group containing them impart chemical properties to the compound and hence are called functional groups.

Heteroatom	Functional Group	Formula
Cl/Br	Halo-(Chloro/Bromo)	$-Cl_2$, -Br
Oxygen	1. Alcohol	–OH
	2. Aldehyde	
	3. Ketone	
	4. Carboxylic acid	

Homologous Series:

- It is a series of compounds in which the same functional group substitutes for hydrogen in a Carbon chain.
- For instance, the ALCOHOLSs: CH_3 OH, C_2H_5 OH, C_3H_7 OH, C_4H_9 OH.
- The successive member differs by $-CH_2$-; unit and 14 units of mass.
- The chemical properties are imparted by the functional group thus all members have similar chemical properties. But the members have different physical properties.
- The physical properties vary among the members of homologous series due to difference in their molecular mass.
- Melting point and boiling point increases with increasing molecular mass.