Covalent Bond → Instead of giving or taking electrons some atoms used to share electrons and hence fullfilling these orbit by making COVALENT BOND.

Carbon have four electrons in it outermost orbits. So,

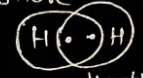
(i) taking 4 electrons to fulfill the orbit making C^{4-} anion is impossible as Carbon will have six protons and ten electrons making it unstable

(ii) giving 4 electrons making C^{4+} cation is also impossible as it requires very high amount of energy.

That's why carbon shares electrons

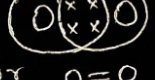
Types of Covalent Bond

i) Single Bond : When each atom share one electron like H_2



or H—H

ii) Double Bond : When each atom share two electrons like O_2



or O=O

iii) Triple Bond : Each atom shares three electrons like N_2

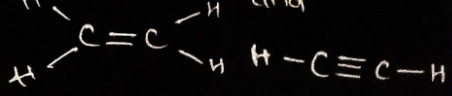
or N≡N

Versatile Carbon : i) Ability to bonds with other atoms and hence can form a large molecule called catenation.

(ii) It has also ability of making four bonds as here it is tetravalent.

SATURATED CARBON COMPOUNDS : When Carbon forms single bond they are called saturated as they are very stable like C_2H_6 (ethane)

UNSATURATED CARBON COMPOUNDS : When carbon form double or triple bond they are called unsaturated like C_2H_4 (ethene) and C_2H_2 (ethyne)



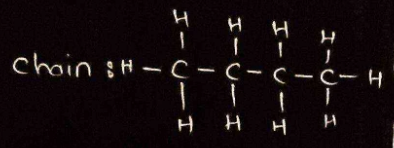
Hydrocarbons : In organic chemistry usually carbons are bonded with hydrogens called hydrocarbons.

Carbon can form chains, branches and rings also.

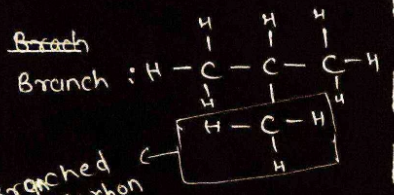
like.

Butane → C_4H_{10}

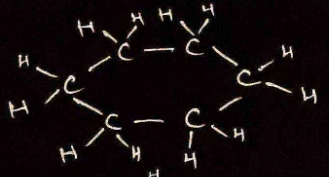
Chain :



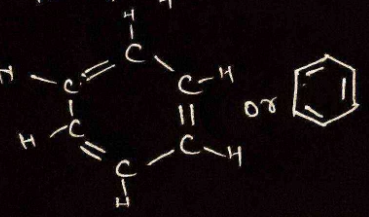
Branch :



Now ring. like cyclohexane C_6H_{12}



and Benzene C_6H_6

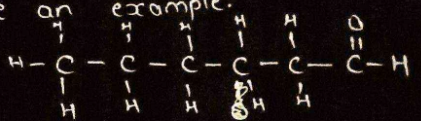


These all things make carbon very friendly and even it can make bonds with other groups also. called Functional groups

Homologous Series : The series in which same functional group always replaces the hydrogen from carbon chain like CH_3OH, C_2H_5OH, C_3H_7OH etc. The difference between two homologous compound is $-CH_2$.

Nomenclature of Carbon Compounds :

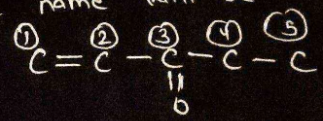
let us take an example.



i) Count the no. of carbons, here it is six So we will say it hexane. If there was any double or triple bond we will say ~~hexene~~ or ~~yne~~ hexene or hexyne respectively.

ii) Here there is $-CHO$ (aldehyde) functional group so we will remove 'e' from hexane and replace it with 'al'. Therefore the name will be hexanal.

other example. :



Couting will start from double bond. five carbons, Hence pentene (as double bond is there) Now ketone at 3rd position so,

pent-3-one (3 determines the position of functional group)

↓ suffix of ketone

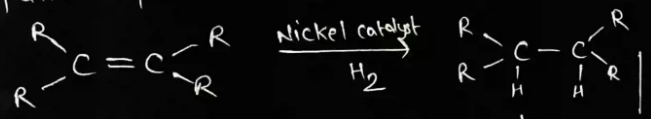
Chemical Properties of Carbon Compounds

i) **COMBUSTION** : Carbon burns in presence of oxygen to give carbon dioxide with heat and light.

$$CH_3CH_2OH + O_2 \longrightarrow CO_2 + H_2O + \text{Heat and light}$$

Saturated hydrocarbon give clean flame but unsaturated one gives yellow flame with black smoke.

ii) **ADDITION** : Unsaturated hydrocarbon add hydrogen in presence of platinum/ Palladium/ Nickel as a catalyst.



iii) **OXIDATION** : Carbon compounds get easily oxidise.

$$CH_3CH_2OH \xrightarrow[\text{Acidified } K_2Cr_2O_7 + \text{Heat}]{\text{Alkaline } KMnO_4 + \text{Heat}} CH_3COOH$$

These substace which help in oxidation are called oxidising agent.

iv) **SUBSTITUTION** : Carbon substitutes hydrogen with other elements, compounds or groups.

$$CH_4 + Cl_2 \longrightarrow CH_3Cl + HCl \quad (\text{in presence of sunlight})$$

Ethanol (C_2H_5OH) : Reaction.

Reaction with sodium : evolve Hydrogen.

$$2Na + 2C_2H_5OH \longrightarrow 2C_2H_5O^-Na^+ + H_2$$
(Sodium ethoxide)

Reaction to give unsaturated hydrocarbon :

$$CH_3CH_2OH \xrightarrow[H_2SO_4]{\text{Hot conc.}} CH_2=CH_2 + H_2O$$

H_2SO_4 (conc.) is strong dehydrating agent as it removes water from compounds.

Ethanoic Acid (CH_3COOH) :

Reaction with alcohol (Esterification) : $CH_3COOH + C_2H_5OH$ $\xrightarrow{\text{Acid}}$ $CH_3-\underset{\underset{O}{\|}}{C}-O-CH_2-CH_3$ (& ster)

Ester is sweet smelling compound. The reverse of this reaction is called saponification.

$$CH_3COOC_2H_5 \xrightarrow{NaOH} C_2H_5OH + CH_3COOH$$

Reaction with base : $CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$ (sodium ethanoate)

CH_3COONa Commonly called sodium acetate.

Reaction with carbonate and hydrogencarbonates:
Gives salt, carbondioxide and water

$$2CH_3COOH + Na_2CO_3 \longrightarrow 2CH_3COONa + H_2O + CO_2$$

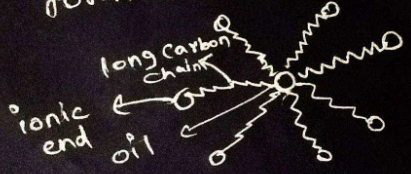
$$CH_3COOH + NaHCO_3 \longrightarrow CH_3COONa + H_2O + CO_2$$

SOAPS AND DETERGENTS :

Soaps are long chain of sodium salts of carboxylic acid

eg. $C_{17}H_{35}COO^-Na^+$ (Sodium stearate).

Most dirt is oily in nature and the long carbon chain are hydrophobic (water hater). So they go and attached to the dirt and the ionic get attached to water as they are hydrophillic (water lover) and hence form a structure called Micelle



But in hard water soap reacts with Calcium and magnesium salt that are present in hard water and hence they form a insoluble substance called scum.

That's why we use detergents which as ammonium or sulphonate salts of long chain carboxylic acid which don't react with calcium or magnesium salt to form scum.

Detergents are used in making shampoos and products for cleaning clothes.