Carbon And Its Compound

Carbon: Carbon is the 15th most abundant in the earth's crust.

Atomic mass :12u.

Atomic number : 6. no. of protons = no. of neutrons = 6

Valency : 4

shell - K L

No. of electrons- 2 4 → elctronic arrangment

6 C Carbon 12.011

Covalent bond

chemical bond that involves the sharing of electrons to form electron pairs between atoms.

Three types of covalent bonding

Single Covalent Bond **Double Covalent Bond** **Triple Covalent Bond**

Properties of Covalent Compounds:

Low melting/boiling points due to weaker intermolecular forces compared to ionic compounds.

- Physical state can be solid, liquid, or gas.
- Poor conductors of electricity as they lack charged particles.
- Generally soluble in organic solvents, insoluble in water (exception: sugar in water).

Catenation: Carbon forms strong covalent bonds with itself, creating chains, branches, or rings.

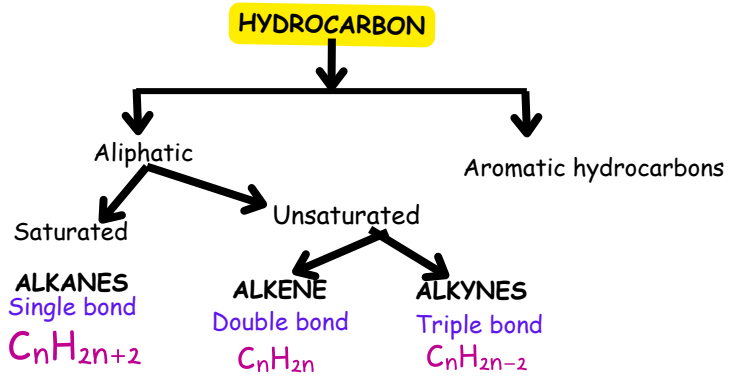
Polymerisation: Small molecules (monomers) join to form large molecules (polymers).

Isomerism: Compounds with the same molecular formula but different structures.

Tetravalency of Carbon: Carbon has four valence electrons, forming four covalent bonds instead of gaining or losing electrons, ensuring stability and diverse organic compounds.

Allotropes: the various physical forms in which an element can exist.

DIAMOND	GRAPHITE	FULLURENCE
3D network, each carbon bonds with four others; very hard.	Layers of hexagons held by weak forces soft and slippery	Hollow, cage-like with 60 carbons; soccer ball shape.
Four strong covalent bonds per carbon; highly stable.	Three covalent bonds per carbon, with delocalized electrons.	Strong covalent bonds in hexagons and pentagons.
Hard, transparent, high refractive index; jewelry, abrasives.	Soft, used in pencils and lubricants.	Unique electronic properties; used in nanotech, drugs.

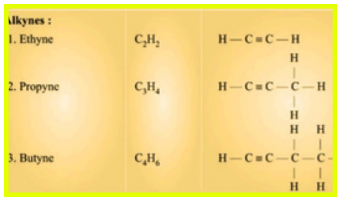


ALKANES

Name	Molecular Formula	Condensed Formula	Structural Formula
Methane	CH_4	CH_4	
Ethane	C_2H_6	H_3CCH_3	
Propane	C_3H_8	$H_3CCH_2CH_3$	
Butane	C_4H_{10}	$H_3C(CH_2)_2CH_3$	
Pentane	C_5H_{12}	$H_3C(CH_2)_3CH_3$	
Hexane	C_6H_{14}	$H_3C(CH_2)_4CH_3$	
Heptane	C_7H_{16}	$H_3C(CH_2)_5CH_3$	

ALKENE

ame of Hydrocarbon	Mileculas formula	Structural Formula
lkenes :		
. Ethene	C_2H_4	
. Propene	C_3H_6	
. Butane	C_4H_8	



ALKYNES

Three types of Hydrocarbons

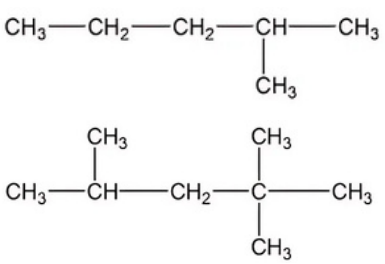
Straight chain : Each carbon atom is bonded to either one or two other carbon atom

Branched chain: Each carbon atom is bonded to one, two, or more than two other carbon atoms

Cyclic Hydrocarbon: Carbon atoms form a closed ring structure. e.g. Cyclohexane (C_6H_{12}), Benzene (C_6H_6).

COMMON NOMENCLATURE: They are named after their sources of isolation. Formic acid derives from "Formectus," meaning red ant, and acetic acid from "Acetum," meaning vinegar.

International Union of Pure and Applied Chemistry (IUPAC), founded in 1919, establishes standardized naming rules in chemistry



NAME THESE

Functional groups:

In hydrocarbons, hydrogen atoms can be replaced by heteroatoms (e.g., Cl, S, N, O), forming functional groups that determine the compound's reactivity and properties.

Rules for Naming Compounds with Functional Groups

Common Functional Groups & Their Formulae:

- Alcohol (-OH) → Ends in -ol (e.g., Ethanol)
- Aldehyde (-CHO) → Ends in -al (e.g., Ethanal)
- Ketone (-CO-) → Ends in -one (e.g., Propanone)
- Carboxylic Acid (-COOH) → Ends in -oic acid (e.g., Ethanoic acid)
- Amine ($-NH_2$) → Ends in -amine or starts with Amino-

Naming Rules:

- Identify the longest carbon chain.
- Number the chain to give the functional group the lowest possible number.
- Functional groups have priority over alkanes, alkenes, and alkynes.
- Use suffix or prefix based on the functional group.
- If multiple groups are present, the most important one gets the suffix.
- Priority Order (Highest to Lowest):
- -COOH > -CHO > -CO- > -OH > $-NH_2$

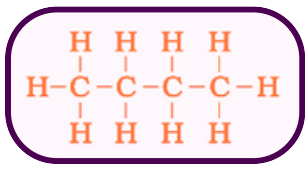
Homologous series:

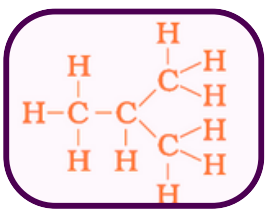
a collection of compounds with the same general formula that differ only in the carbon chain length.

-Homologues share the same general formula.

- Differ by a $-CH_2$ group; molecular mass difference is 14 μ.
- Similar chemical properties.
- Gradual change in physical properties.
- Functional group influences properties.

Isomerism Compounds with identical molecular formula but different structures.





Chemical properties of carbon Compounds

Combustion (Burning)

Carbon compounds burn in oxygen (O_2) to form CO_2, H_2O, and heat.Example: $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ + Heat

Oxidation

Alcohols are oxidized to acids using $KMnO_4$ or $K_2Cr_2O_7$.
Example: $CH_3CH_2OH + [O] \rightarrow CH_3COOH$

Addition Reaction

Unsaturated hydrocarbons (alkenes, alkynes) add H_2 in the presence of Ni/Pd catalyst.
Example: $CH_2=CH_2 + H_2 \rightarrow CH_3-CH_3$

Substitution Reaction

Alkanes react with halogens (Cl_2, Br_2) in the presence of sunlight.
Example: $CH_4 + Cl_2 \rightarrow$ (Sunlight) $\rightarrow CH_3Cl + HCl$

Chemical properties of Ethanol and Ethanoic Acid

Ethanol (C_2H_5OH):

Physical Properties of Ethanol:

- Ethanol is a liquid at room temperature.
- It is soluble in water in all proportions.
- Commonly known as alcohol, it is the active ingredient in alcoholic drinks.
- It is a good solvent, used in medicines like tincture iodine, cough syrups, and tonics.

Reactions of Ethanol:

Reaction with Sodium: Ethanol reacts with sodium, producing hydrogen gas and sodium ethoxide.

- Equation: $2Na + 2C_2H_5OH \rightarrow 2C_2H_5O^-Na^+ + H_2$

Dehydration of Ethanol to Ethene:

- Ethanol is heated with excess concentrated sulphuric acid at 443 K, leading to the removal of water (dehydration) and formation of ethene.
- Equation: $C_2H_5OH \rightarrow CH_2=CH_2 + H_2O$ **(In presence of hot conc. H_2SO_4)**
- Sulphuric acid acts as a dehydrating agent.

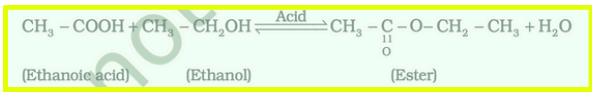
Denatured alcohol is ethanol mixed with chemicals to make it unfit for drinking. It is used in industries for cleaning, fuel, and as a solvent. The added substances, like methanol, make it poisonous and undrinkable to avoid misuse. Denatured alcohol is cheaper than pure ethanol due to tax exemptions.

Ethanoic Acid (CH_3COOH):

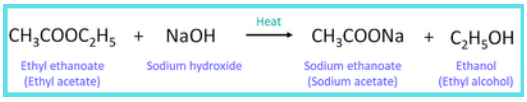
Commonly known as **acetic acid**, belongs to the carboxylic acid group. 5-8% solution in water is called vinegar, used as a preservative in pickles. Melting point: 290 K; freezes in winter, hence called glacial acetic acid. Weak acid compared to mineral acids like HCl (does not fully ionize in water).

Reactions of Ethanoic Acid:

1. Esterification Reaction: Reacts with ethanol in the presence of concentrated H_2SO_4 to form ester (sweet-smelling, used in perfumes & flavoring agents).



2. Saponification reaction: Process of converting esters into salts of carboxylic acids and ethanol by treating them with a base.



3. Reaction with Bases: Reacts with sodium hydroxide to form sodium ethanoate (sodium acetate) and water.

$$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$$

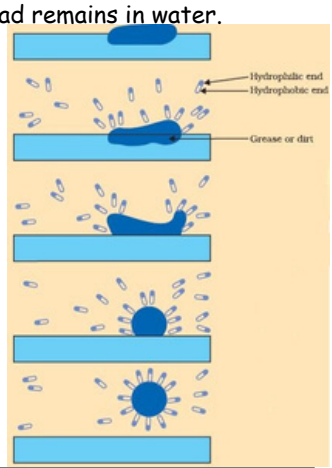
4. Reaction with Carbonates and Hydrogencarbonates: Reacts with Na_2CO_3 or $NaHCO_3$, producing carbon dioxide, water, and sodium acetate.

$$2CH_3COOH + Na_2CO_3 \rightarrow 2CH_3COONa + H_2O + CO_2$$
$$CH_3COOH + NaHCO_3 \rightarrow CH_3COONa + H_2O + CO_2$$

Structure of Soap/Detergent Molecule

- Soap/Detergent molecules have two ends:
  - Hydrophilic head (Water-attracting, polar)
  - Hydrophobic tail (Oil-attracting, non-polar)
- Cleansing Process (Micelle Formation)
- Oil and dirt do not mix with water.
- When soap/detergent is added, the hydrophobic tail attaches to grease/dirt, while the hydrophilic head remains in water.
- The molecules arrange themselves in a micelle structure, surrounding the dirt.
- The dirt gets trapped inside micelles and is lifted off the surface.
- When rinsed with water, the micelles are washed away, removing dirt

Soap molecule



Soap	Detergents
Molecules of soap are sodium or potassium salts of long-chain carboxylic acids.	Detergents are sodium salts of sulphonic acids or ammonium salts with chloride or bromide ions.
Not so effective in hard water.	Effective even in hard water.
Relatively weak cleansing action.	Strong cleansing action.
Soaps are biodegradable.	Most of them are non-biodegradable.

Hard Water	Soft Water
Contains high mineral content, mainly calcium (Ca^{2+}) and magnesium (Mg^{2+}) ions.	Contains low mineral content, mainly sodium (Na^+) or potassium (K^+) ions.
Does not lather easily with soap.	Lathers easily with soap.
Forms scum and scale in pipes, boilers, and appliances.	Does not form scum or scale.
Can cause roughness in hair and skin.	Feels smooth on skin and hair.
Example: Groundwater, well water.	Example: Rainwater, distilled water.

Chapter ka KAZAANA:

- *IUPAC Naming*
- *Electron Dot Structure (Ethanol, Amine)*
- *Homologous Series (MCQs)*
- *Important Reactions: Esterification, Saponification, Dehydration of Ethanol*
- *Working of Soap (diagram)*