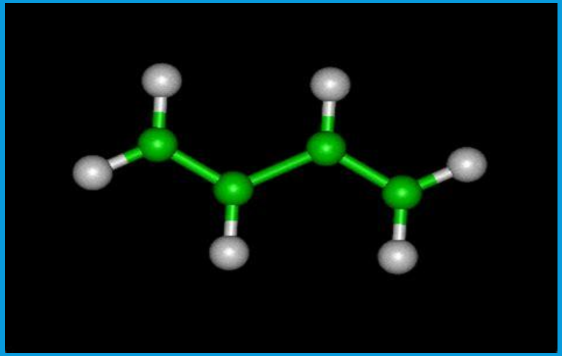
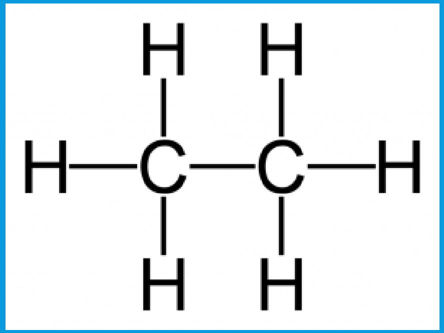
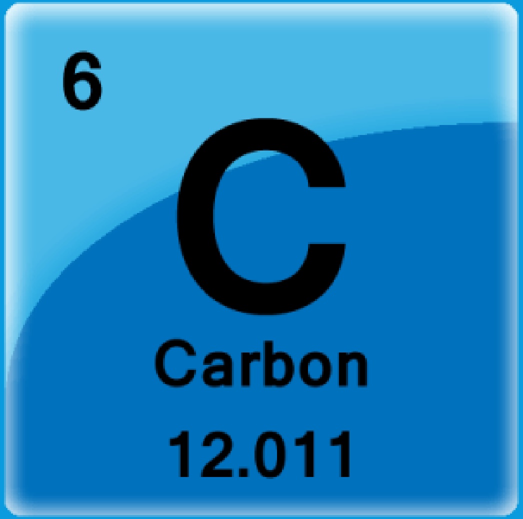




CARBON AND ITS COMPOUNDS

CLASS 10TH CHEMISITRY



GLOSSARY

- Soaps and detergents
- Catenation
- Tetravalency
- Allotropes.
- Fullerenes
- Isomers
- HS and FGs
- HCs
- Chemical Reactions

CARBON

- 6th element of the periodic table. AM → **12u. NON-METAL.**
- Tetravalent. Has only 4 atoms in the outermost shell. This leaves C with no other choice but to share its valence electrons.
- **Forms** covalent bonds with elements, even with itself.

K	L
2	4

- Has a unique property of catenation or self combination. This allows Carbon to form really long chains with other Carbon atoms.
- Organic Chemistry.
- Occurrence → **Free State** and **Combined State.**

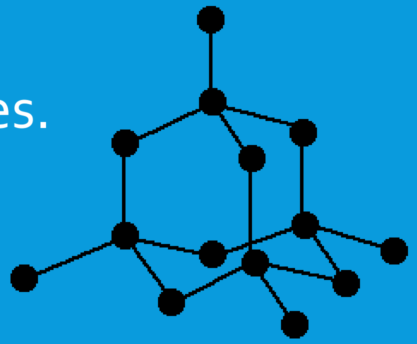
Salts: Carbonates

Allotropes of C

Organic Compounds

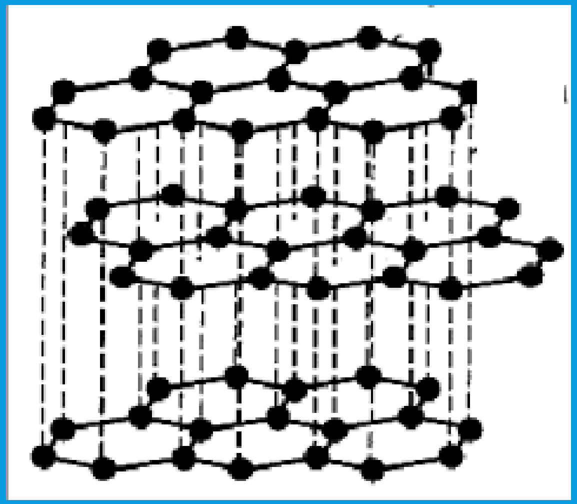
ALLOTROPES OF CARBON

- **The various physical form in which an element can exist are called its allotropes.**
- **Diamond**: Each carbon atom is bonded to 4 other Carbon atom in a tetrahedral fashion. This forms a 3d structure in which bond is even stronger than some ionic compounds.
- Colourless, transparent substance. Heavy, dense, extremely hard. In fact, it is the hardest ever known compound to the humanity. Non-conductor of electricity.
- Burns in air to release large amount of heat and CO_2. Melting and boiling points are high.
- Glass Cutters, used for cataract removal. Main usage : Jewelleries.



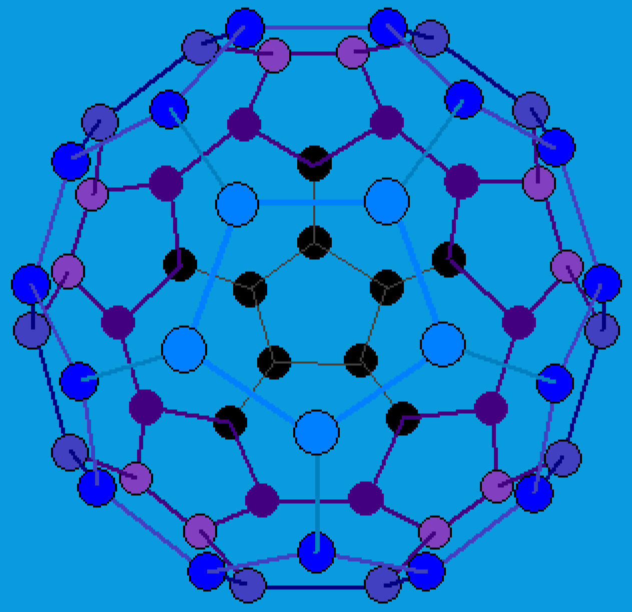
GRAPHITE

- Grayish black opaque substance.
- Weak, frail sheets. Good conductor of electricity. Burns.
- 2d planar hexagonal structure. Therefore exists in form of sheets. Slippery to touch. Different sheets are held together by weak Van Der Waals forces.
- Used in Pencil leads, cells and for lubrication purposes.



BUCKMINSTERFULLERENE

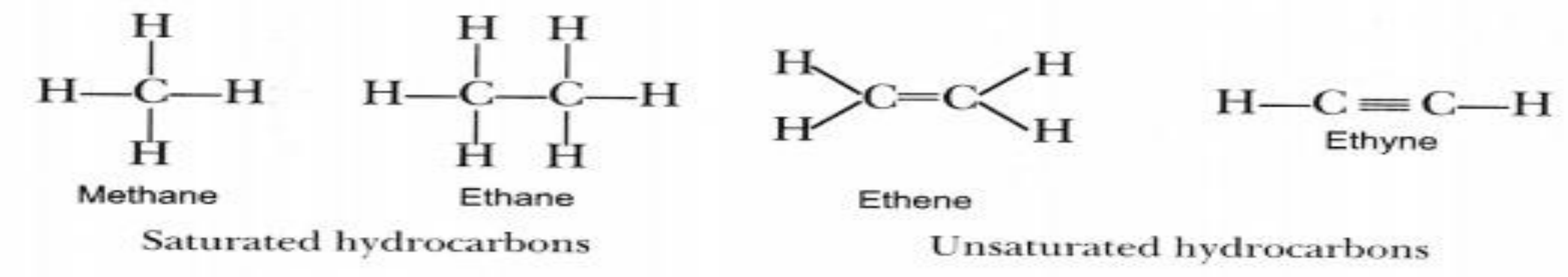
- Comes from the class of fullerenes.
- 60 carbon atoms joined together in a soccer-ball like structure.
- 3d structure.
- Interlocking (20) hexagonal and (12) pentagonal rings.
- Named after Buckminster Fuller.
- Small molecule. Neither extremely hard nor soft.
- Dark solid at room temperature.
- Pentagons are in contact with hexagons only. BUT hexagons are in contact with both pentagons and hexagons.



LARGE NUMBER OF ORGANIC COMPOUNDS

- Concatenation allows Carbon to form long chains with other Carbon atoms
- Saturated and Unsaturated CC.
- Tetravalency allows Carbon to form simple chains with other elements.
- Size of Carbon atom is quite small, therefore bonds formed are quite strong. This allows nucleus to hold the bonding pair of electrons quite strongly.

Saturated Compounds	Unsaturated Compounds
Contain single(inter-carbon) C-C bond.	Contain multiple (inter-carbon)C-C bonds



STRAIGHT, BRANCHES AND RINGS

- Isomers: The OCs that have same molecular formula but different spatial structures.

FUNCTIONAL GROUPS

- Group of atoms that decides the chemical properties of a compound(carbon chain).
- Hydroxy, Carbonyl, Halo, Acid.

HOMOLOGOUS SERIES

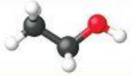
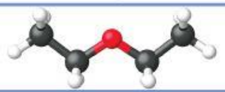
- A series of carbon compounds in which each successive member differs by a
- $-CH_2-$ unit or its molecular mass differs by 14u.
- The melting and boiling points increase as we go up in the homologous series. WHY?
- A **functional group/presence of unsaturated bond** decide the homologous series.

THE HOMOLOGOUS SERIES

# C's	Alkane Structure	Parent name	Substituent name
1	CH_4	methane	methyl
2	CH_3CH_3	ethane	ethyl
3	$CH_3CH_2CH_3$	propane	propyl
4	$CH_3CH_2CH_2CH_3$	butane	butyl
5	$CH_3CH_2CH_2CH_2CH_3$	pentane	pentyl
6	$CH_3CH_2CH_2CH_2CH_2CH_3$	hexane	hexyl
7	$CH_3CH_2CH_2CH_2CH_2CH_2CH_3$	heptane	heptyl
8	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_3$	octane	octyl
9	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_3$	nonane	nonyl
10	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_3$	decane	decyl

NOMENCLATURE→IUPAC

- Identify the parent chain.
- Identify the functional group, if present.
- Recall the prefix and suffix, whatever to be used, as the case may be.
- Check whether a double or triple bond is present.

Compound Name	Structure of Compound and Functional Group (red)	Example		
		Formula		Name
alkene	C═C	C_2H_4		ethene
alkyne	C≡C	C_2H_2		ethyne
alcohol	R—Ö—H	CH_3CH_2OH		ethanol
ether	R—Ö—R′	$(C_2H_5)_2O$		diethyl ether
aldehyde	R—C(═Ö)—H	CH_3CHO		ethanal
ketone	R—C(═Ö)—R′	$CH_3COCH_2CH_3$		methyl ethyl ketone
carboxylic acid	R—C(═Ö)—Ö—H	CH_3COOH		acetic acid
ester	R—C(═Ö)—Ö—R′	$CH_3CO_2CH_2CH_3$		ethyl acetate
amine	R—N̈(—H)—H R—N̈(—R′)—H R—N̈(—R′)—R″	$C_2H_5NH_2$		ethylamine
amide	R—C(═Ö)—N̈(—H)—R′	CH_3CONH_2		acetamide

CHEMICAL PROPERTIES

- Combustion: The burning of a substance in presence of O_2 to give out heat and light is called combustion.
- Alkanes are excellent fuels and give out a clean blue flame while unsaturated counterparts give out yellow sooty flame. WHY?
- In limited supply of O_2, even saturated HCs give a sooty flame.
- A flame is produced is produced if volatile gaseous substances burn.
- Fossil fuels…

OXIDATION

- In a vague sense, addition of oxygen to a compound is oxidation.
- Oxidising agents : $KMnO_4$ or $K_2Cr_2O_7$ or $KCrO_4$.
- Example:

ADDITION REACTION

- Addition of hydrogen/halo or any group across the multiple bond resulting in loss of unsaturation.
- Nickel is mainly used as a catalyst for hydrogenation.
- Addition of hydrogen is also called hydrogenation reaction
- It is used to convert vegetable oil (unsaturated) to vegetable ghee (saturated).
- Example:

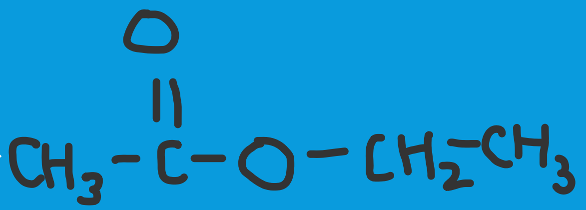
SUBSTITUTION

- Saturated HCs are mainly inert.
- But in presence of sunlight Halogens, mainly chlorine can be substituted in place of hydrogen atoms of an SHC.
- The reaction in which one or more H-atoms of an HC are replaced by some other atoms is called a substitution reaction.
- Example: $CH_4 + Cl_2 \rightarrow CH_3Cl + HCl \rightarrow CH_2Cl_2 + HCl \rightarrow CHCl_3 + HCl \rightarrow CCl_4 + HCl$

ETHANOL AKA ETHYL ALCOHOL

- Used in making of spirit and alcoholic beverages.
- Commonly called: Alcohol.
- Good solvent. Liquid at room temperature. Excellent fuel.
- Used in making tincture of iodine, cough syrups and many other compounds.
- 100% pure ethanol → Absolute alcohol.
- Commercially available as Rectified spirit → 95% pure .
- 78°C is the B.P.
- Slightly acidic; Blue to red.
- Chemical properties are like every other alcohol.

REACTIONS

- Reaction with sodium metal
- $2Na + 2CH_3CH_2OH \rightarrow 2CH_3CH_2ONa + H_2$
- Dehydration of alcohol
- $CH_3CH_2OH + H_2SO_4$ (443K) $\rightarrow CH_2{=}CH_2 + H_2O$
- Esterification reaction
- $CH_3CH_2OH + CH_3COOH$ (in presence of an acid like H_2SO_4) $\rightarrow$ 

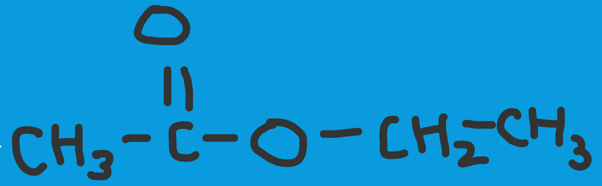
DENATURED ALCOHOL

- Methanol is added to ethanol to prevent the misuse.
- Ethanol is used for commercial purposes.
- Other additives: $CuSO_4$ and Pyridine.
- The ethanol that has been made unfit for drinking by adding small quantities of poisonous substances is known as denatured alcohol.
- Methanol in even small quantities is poisonous and fatal and can cause blindness if taken in very small amounts. It gets oxidised to form methanol in human liver.

ETHANOIC ACID AKA ACETIC ACID

- Glacial acetic acid. B.P → 118^{o}C
- Sour taste and is used to make vinegar(5-8%).
- Blue to red litmus.
- pH ~ 4.
- Preservation of pickles. Food preservative. Making of sauce.
- Used for making cellulose acetate and polymers.
- Majorly used for making other OCs.

REACTIONS

- Esterification reaction
- $CH_3CH_2OH + CH_3COOH$ (in presence of an acid like H_2SO_4) → 
- Saponification: Esters react with an acid or a base to give back the corresponding alcohol and carboxylic acid. This is hydrolysis.
- $CH_3COOCH_2CH_3 + NaOH \rightarrow C_2H_5OH + CH_3COONa$
- Reaction with a base : $NaOH + CH_3COOH \rightarrow CH_3COONa + H_2O$
- Reaction with (hydrogen)carbonates : Give salt, CO_2 and H_2O.
- $2CH_3COOH + Na_2CO_3 \rightarrow 2CH_3COONa + H_2O + CO_2$
- $CH_3COOH + NaHCO_3 \rightarrow CH_3COONa + H_2O + CO_2$

Soap vs. Detergents

Soaps	Detergents
They contain sodium carboxylate (COONa) group.	They contain sodium sulphonate (SO_3Na) group.
They are not suitable for washing with hard water.	They are suitable for both hard and soft water.
They have relatively weak cleansing action.	They have strong cleansing action.
They are biodegradable.	Most of them are non-biodegradable.

Hard water contains minerals w/ions like Ca^{2+}, Mg^{2+}, and Fe^{3+} that replace Na^{1+} at polar end of soap molecule.

Soap is changed into an insoluble precipitate (i.e., soap scum).