CARBON $ IT'S COMPOUNDS

- Human body is made of 18% carbon.
- atomic mass :- 12 u
- atomic number :- 6.
- The earth's crust has only 0.02% carbon in the form of minerals.
- The atmosphere has 0.03% of carbon dioxide.

COVALENT BOND:
(bonds formed by sharing of electrons.)

★ ionic bond have high melting and boiling point and conduct electricity in solution or in the molten state.

Q. Why do carbon compound not conduct electricity?
→ this is because the force of attraction between the molecules are not very strong. Since these are largely non conductors of electricity we can conclude that the bonding in these compounds does not give rise to any ions. [same answer in case of melting and boiling point]

★ Q. **WHY CARBON COMPOUNDS ★ DO NOT FORM IONIC BOND?** ★

→ because:

i] Carbon could gain $4e^-$ forming C^{4-} anion. But it would be difficult for the nucleus with 6 protons to hold 10 electrons that is 4 extra electrons.

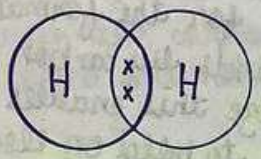
ii] Carbon could lose $4e^-$ forming C^{4+} cation. But it would require a large amount of energy to remove four electron leaving behind a carbon cation with $6p^+$ in its nucleus holding onto just $2e^-$.

∴ Carbon overcomes this problem by forming covalent bond.

mcq: which is the simplest molecule formed by covalent bond.
→ hydrogen

Q. Is covalent bonds weak?

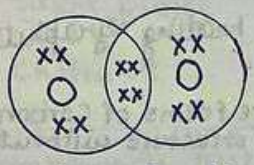
→ No, the bond is strong, the intra molecular force is strong but the inter-molecular force is weak making it a little weak in comparision to other bonds.



H_2 molecule.

- a single covalent bond is represented by a line between 2 atoms.

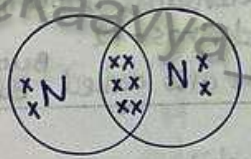
H–H



O_2 molecule

- a double covalent bond is represented by 2 lines between 2 atoms.

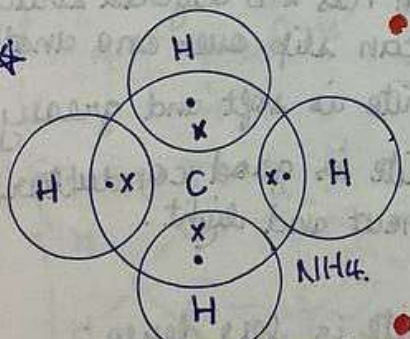
O=O



N_2 molecule

- a triple covalent bond is represented by 3 lines between 2 atoms.

N≡N



NH_4.

Electron dot structure methane.

methane:-

- widely used as fuel and is a major component of duo gas and CNG.
- simplest Carbon compound

Why Carbon Why ?!.

Catenation

[The unique ability to form bond with other atoms of carbon, giving rise to large molecules. This property is called self linking or catenation.] Definition

- silicon forms compounds with hydrogen which have chains of upto 7 or 8 atoms, but these compounds are reactive.
- The carbon-compounds is very strong and hence stable.
- That is why many carbons can be linked.

Tetra-valency.

- bonds that carbon form are highly stable.
- one reason for the formation of strong bonds by carbon is its small size this enables the nucleus to hold on electrons.

Fullerences:-

→ fullerences are made of heating graphite in presence of inert gas.

→ fullerence are only pure forms of Carbon. Because they have smooth structure without having dangling bonds.

→ Buckminsterfullerene contains 6 membered rings - 20 ; 5 membered rings - 12.

→ spherical fullerene are also called Bucky Balls.

Allotropes of carbon

diamond

i] diamond has a 3-D rigid structure

ii] diamond is the hardest substance known.

iii] diamond is bad conductor of electricity but good cond^{r} of heat.

iv] diamond has high density

v] transparent

Graphite.

i] graphite has 2-D layered structure. Layers can slip over one another.

ii] graphite is soft and greasy.

iii] graphite is good conductor of both heat and light.

iv] graphite is less dense.

v] opaque.

carbon compounds.

Saturated hydro carbon [not very reactive]

[compounds of carbon which are linked by only single bond between the carbon atoms are called saturated compound]

- alkane
  - single bond
  - C_nH_{2n+2}

Unsaturated hydrocarbon [more reactive]

[compounds of compounds which are liked by double or triple bond between the carbon atoms are called unsaturated compound]

- alkene
  - double bond
  - C_nH_{2n}
- alkyne
  - triple bond.
  - C_nH_{2n-2}

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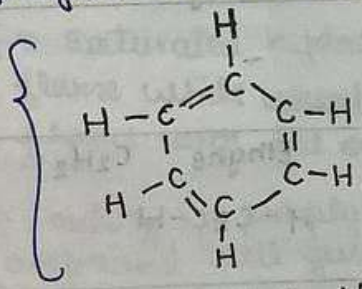
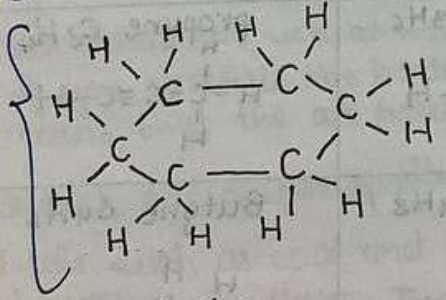
* compounds with identical molecular formula but different structures are called structural isomers.

* cyclic carbon compound



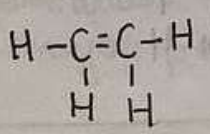
BENZENE
C_6H_6.



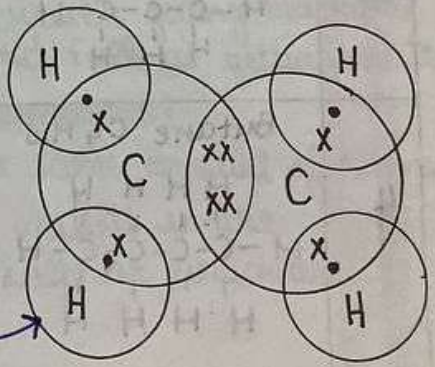
cyclohexane
C_6H_{12}

* all these structure of carbon compound which contain only carbon and hydrogen are called hydrocarbon.

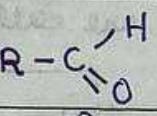
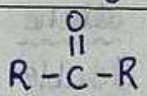
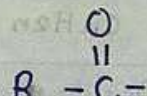
bond line notation.



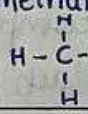
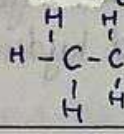
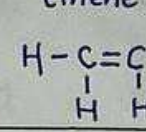
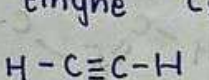
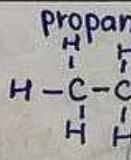
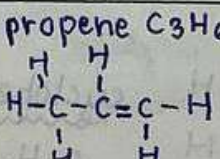
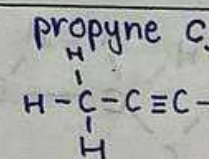
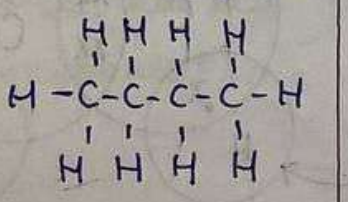
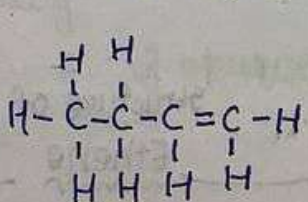
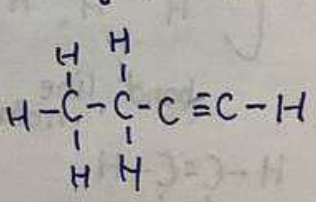
Structure of Ethene



electron dot

Class of compounds	Formula of Functional group	suffix
Halo-alkane	i] Fluoro - F ii] Chlorine - Cl iii] Bromine - Br iv] Iodo - I	- fluoro -Chloro -Bromo - Iodo.
Alcohol	-OH	- ol.
Aldehyde		- al
Ketone		- one
★ Carboxylic acid ★		- oic

HOMOLOGOUS

no of carbon	alkane	alkene	alkyne
1	methane CH_4 	-	-
2	Ethane C_2H_6 	Ethene C_2H_4 	Ethyne C_2H_2 
3	Propane C_3H_8 	propene C_3H_6 	propyne C_3H_4 
4	Butane C_4H_{10} 	Butene C_4H_8 	Butyne C_4H_6 

Homologous series : group of organic compounds having similar structure and chemical properties in which successive compound differ by CH_2 group.

Chemical properties of carbon

Combustion
combustion is a chemical reactⁿ in which carbon reacts with O_2 to produce CO_2 with heat & light.

Oxidation
The reactⁿ in which oxygen is gained or Hydrogen is lost.

Addition
when an unsaturated Hydrocarbon combines with H_2 to give single product in presence of a catalyst.

Substitution
A reaction in which a functional group of chemical compound replaces functional grp of another compound.

Combustion:

- $C + O_2 \rightarrow CO_2$ + heat and light
- $CH_4 + O_2 \rightarrow CO_2 + H_2O$ + heat and light
- $CH_3CH_2OH + O_2 \rightarrow CO_2 + H_2O$ + heat and light

** Saturated hydrocompounds will generally give a clean flame while unsaturated hydrocompound will give a yellow flame with lot of black smoke.

* limiting O_2 supply while combustion of even saturated hydrocompound will give sooty flame.

→ the stove we use at home has outlets for O_2 supply
→ if you observe the bottom of cooking vessels getting blackened it means that the air holes are blocked and fuel is getting wasted.

Q. which are major pollutants of environment?
→ Fuels such as coal and petroleum have some amount of Nitrogen and sulphur in them. Their combustion results in the formation of oxides of Nitrogen and sulphur which are major pollutants of environment.

Q. why do substances burn with or without a flame?

→ coal and charcoal sometimes just glow red gives out heat without flame this is because flame is only produced when gaseous substances burn. when wood is ignited the volatile substance present vapourises and burn with a flame in the beginning.

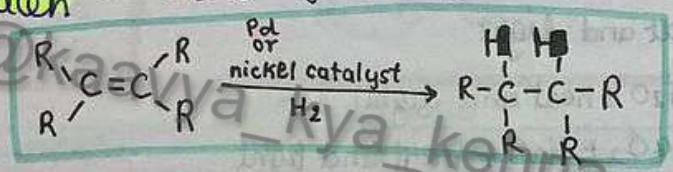
Oxidation

$$CH_3-CH_2OH \xrightarrow[\text{or } K_2Cr_2O_7 + \text{Heat}]{\text{alkaline } KMnO_4 + \text{Heat}} CH_3COOH$$

ethanol → acetic acid

⇒ alkaline potassium permanganate or acidified potassium dichromate are added to start the reaction. Hence known as oxidising agents.

Addition [fast] [Hydrogenation]



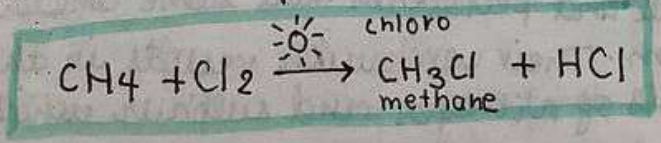
* catalyst are substances that cause a reaction to occur or proceed at different rate without the reaction itself being affected.

vegetable oils → Long chains of unsaturated hydro compounds → goooood

Animal fats → Saturated hydro compounds. → baaad

Substitution [slow]

* saturated hydrocompounds are mostly unreactive
* But when in presence of sunlight Cl_2 is added ☆ the react^n is fast.

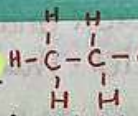


$$CH_4 + Cl_2 \xrightarrow{\text{sunlight}} CH_3Cl + HCl$$

इथ परीवार

Ethanol
CH_3CH_2OH
or
C_2H_5OH

Ethanoic acid.
CH_3COOH.

Ethanol 

- is liquid at room temprature
- commonly called alcohol and is ~~a~~ active ingredient of alcoholic drinks.
- as it is a good solvent it is used in medicines.
- consumption of small quantities can cause drunkness.

imp reactions

reaction with Sodium

$\Rightarrow 2Na + 2CH_3CH_2OH \rightarrow 2CH_3CH_2O^-Na^+ + H_2$
(sodium ethoxide)

reaction with to make unsaturated hydrocarbon and dehydrate.

$\Rightarrow CH_3-CH_2OH \xrightarrow[H_2SO_4]{\text{Hot-conc}} CH_2=CH_2 + H_2O$
Ethene

- Heating ethanol at 443K.
- results in dehydration of ethanol & give ethene.

- when large amt of Ethanol is consumed it slows metabolic processes and depresses CNS.
- intake of methanol can cause death. methanol is oxidised to methanal in liver. so it reats rapidly with cells and coagulate protoplasm.
- Dyes are added to colour ethanol so that it is identified. This is called denatured alcohol.
- rectified spirit → 5% H_2O + 95% E

melting point of Ethanol:
156K

Boiling point of Ethanol:
351K.

Ethanoic Acid

- commonly called acetic acid and belongs to group of acid called carboxylic acid.
- vinegar : 5-8% of Acetic acid + H_2O

- why ethanoic acid is called glacial acetic acid ?

→ The melting point of pure ethanoic acid is 290K and hence it often freezes during winter in cold climates. This gave rise to its name glacial acetic acid.

- Carboxylic acid → acidic nature ; weak acid.
- mineral acid → completely ionize

important reactions

Esterification reaction

- sweet smelling substance
- used for perfumes & flavouring agents.

- $CH_3-COOH + CH_3CH_2OH \rightarrow$

$CH_3-\underset{\underset{O}{\|}}{C}-O-CH_2-CH_3 + H_2O$

Ester or Ethyl Ethonate.

reaction with base

- on react^n with NaOH it is converted back to alcohol and sodium salt of carboxylic acid. This react^n is known as saponification.

- $CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$

reaction with carbonates & Hydrogen-carbonates

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

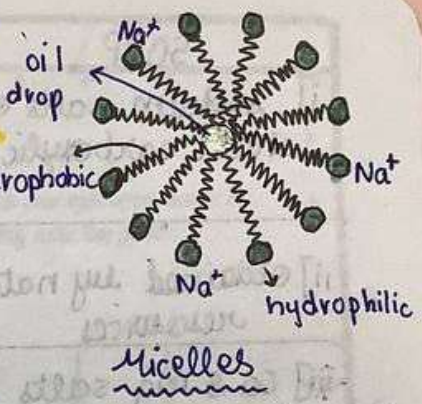
- $CH_3COOH + NaHCO_3 \rightarrow CH_3COONa + H_2O + CO_2$.

Saponification :

- $\underset{\text{Ester}}{CH_3COOC_2H_5} + NaOH \xrightarrow{\Delta} \underset{\text{Ethyl}}{C_2H_5OH} + \underset{\text{Sodium ethonate}}{CH_3COONa}$.

- making soap

SOAPS AND DETERGENTS.



* Most dirt and oily substances do not dissolve in water. The molecules of soap and sodium or potassium salts of long chain carboxylic acid.
* The ionic-end of soap interacts with H_2O while carbon chain interacts with oil.
* The soap molecule thus forms structure called micelles.
* This forms emulsion in water.

- molecules have a unique orientation that keeps the hydrogen carbonate out of the water. Thus cluster of molecules in which the hydropholic tail are inside and ionic are at ends. This formation is called micelles.

- soap in form of micelles is able to clean since oily dirt will be collected in center.
- The micelles stay in solution as colloid and will not come together to precipitate because of ion-ion repulsion. Thus the dirt is rinsed away.

* The soap micelles are large enough to scatter light. Hence a soap sol^n appears cloudy.

SOAP	DETERGENTS
i] sodium salts of long chain carboxylic acids	i] sodium salts of sulphonic acid or ammonium ~~acid~~ salts with Cl & Br.
ii] obtained by natural resources	ii] obtained by synthetic material
iii] Ca & mg salts are insoluble	iii] Ca & Mg are soluble.
iv] Produces scum in Hard water	iv] Hard water does not affect its action.
v] Biodegradable	v] Non biodegradable.