

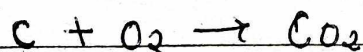
Chapter 4

Carbon and its compounds.

Some facts about carbon

- Carbon is the 15th most abundant element in the earth's crust.
- Earth's crust has 0.02% carbon in form of mineral like:
 - a) Carbonates
 - b) Hydrogen carbonates
 - c) coal and petroleum.
- Carbon is present in the atmosphere primarily in the form of carbon dioxide. Its concentration in the atmosphere is 0.03%.
- The shells of aquatic animals are made from calcium carbonate.
- Human body contains 18% carbon.

On burning a compound containing carbon, it will produce an odourless and colourless gas called carbon dioxide.



→ Extinguishes burning matchstick

→ Turns moist blue litmus paper → red.

confirmatory test: $Ca(OH)_2(aq) + CO_2(g) \rightarrow CaCO_3(s) + H_2O(l)$

Introduction to covalent Bonding.

* Covalency

eg → Hydrogen requires 1 more electron to attain duplet configuration, like Helium.

→ Each hydrogen atom shows 1 electron. It is monovalent and shows monovalency.

→ There is a single covalent bond between two hydrogen atoms.



Ex → Oxygen requires 2 more electrons to attain configuration.



→ Each oxygen atom shows 2 electrons. It is divalent and shows divalency.

→ There is a double covalent bond between two oxygen atoms.

ex: Nitrogen (N) → non metal. It requires 3 more electrons to become stable.



→ Each nitrogen atom shows 3 electrons. It is trivalent and shows trivalency.

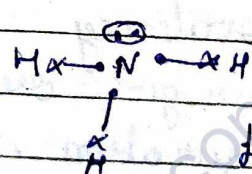
→ There is a triple covalent bond between two nitrogen atoms.

covalent bond :- A chemical bond in which sharing of electrons take place between non-metals covalently bonded elements.

H_2 , Cl_2 , N_2 , O_2 etc.

covalently bonded compounds

1) Ammonia (NH_3)



Bond pair = 3

lone pair = 1

Gain why carbon cannot gain ^{or lose} 4 electrons?

→ Due to small size of carbon, 6 protons can't hold 10 electrons.

→ Repulsion between electrons increases.

→ Loss:- Not energetically feasible.

→ C^{4+} is unstable as it has 6 protons in its nucleus holding on to just two electrons.

* Maximum one C can make triple bond with another C atom.

Properties of covalent compounds

→ Made from Molecules

→ physical state solid, liquid and gas.

→ Electrical conductivity ~~is~~ Generally poor conductor of electricity.

→ Solubility Generally soluble in organic solvents and insoluble in water.

→ Melting and boiling point low because of weak intermolecular force of attraction.

$H_2O - H_2O \vdash H_2O \rightarrow$ intermolecular force of attraction is weak
intramolecular bond is strong

Versatile Nature of carbon

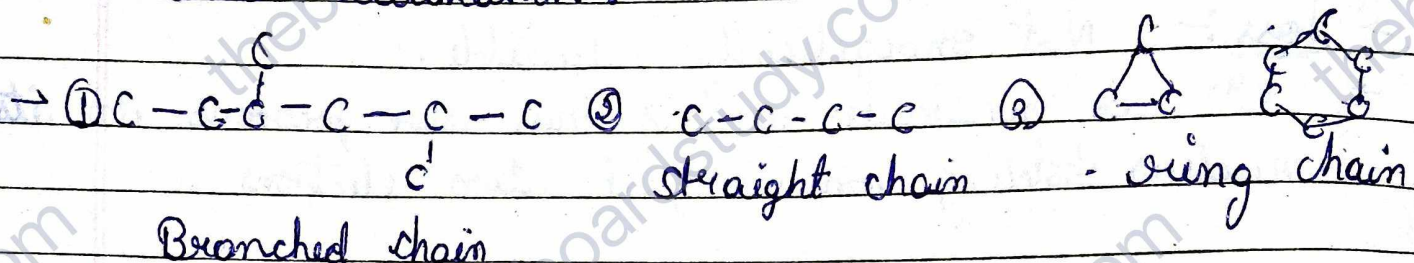
* Tetravalency

Each -C atom shares 4 electrons to attain nearest stable noble gas configuration.

shows tetravalency and -C atom is tetravalent.

* catenation

The self linking property of carbon to form long straight, branched and closed rings is called catenation.



* Multiple bond formation.

Carbon has a tendency to form multiple bonds like single, double and triple with different elements.

* Allotropes

Some elements exist in the different physical structures while being in the same physical state are called allotropes and this phenomenon is known as allotropy or allotropism.

Types of Allotropes

① Crystalline

fixed geometrical shape

① Natural

① Diamond

② Graphite

② Synthetic

① Fullerene

② Amorphous

No fixed geometrical shape.

→ Coke

→ Lamp black

→ ~~Gas~~ carbon

→ charcoal

Diamond.

- Natural crystalline form of carbon.
- Purest form of carbon.
- Raw diamonds don't shine.
- Purest form of amorphous carbon sugar charcoal.

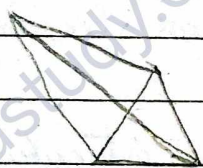
Structure of diamond

8 carbon atoms at corners (1 of each corner)

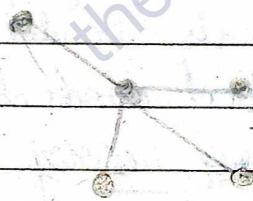
6 carbon atoms at face (1 of each face)

4 Carbon atoms in between

Tetrahedron



Place C
atom at each
corner



Carbon atoms
from overall 3D
crystal structure at
Tetrahedral unit - diamond

Properties of diamond

- Hard :- Naturally occurring hardest substance.
- High M.P :- strong covalent bonds b/w C atoms.
- Best conductor of heat :- Atomic vibration (Phonons)
- Poor conductor of electricity :- No free/delocalised e^- because each carbon atom is bonded to 4 other C atoms.

Use of diamond.

- In jewellery, due to extraordinary brilliance and durability (unreactive/hard).
- In industries, to cut, drill or grind other materials due to its hardness.

Graphite

- Archaisically referred to as 'Plumbago' or black lead
- Smooth and slippery to touch
- Greyish black in colour
- Opaque
- Brittle, lustrous

Structure of Graphite (N)

- Ball and stick model of graphite carbon covalent bond
- Natural crystalline form of C
- each layer is called graphane. adjacent layers are some
- each C atom is bonded to 3 other C atoms leaving a free e^- - a good conductor of electricity
- Hexagonal ~~and~~ honey comb structure
- Bond betw C atoms in a layer is strong covalent bond
- Weak ~~bond~~ betw layers is force of attraction betw layers → Vanderwaal force of attraction



Uses of graphite

- It is used as a solid lubricant for machine parts
reduces friction betw surface in contact
- It is used to make artificial diamonds
Graphite $\xrightarrow[\text{Absence of } O_2]{\text{HT, HP}}$ Diamond

Buckminster fullerene

The first discovered fullerene, C_{60} was named after a US architect Buckminster fuller as the

Structure of C_{60} was similar to the geodesic dome designed by him.

Structure of C_{60} (Dark solid at room temp)
It contains 20 six membered rings and 12 five membered rings. The six membered rings make bonds with five and six membered rings while five membered rings only make bonds with six membered rings.
The structure is also known as soccer ball like structure or bucky ball structure.

Early Theory of Organic and inorganic compounds
compound such as urea, sugar etc. that are obtained directly or indirectly from living sources such as plants and animals are organic compounds while compounds such as salt, marble, alum etc. which were obtained from non-living sources such as rocks and minerals are called inorganic compounds.

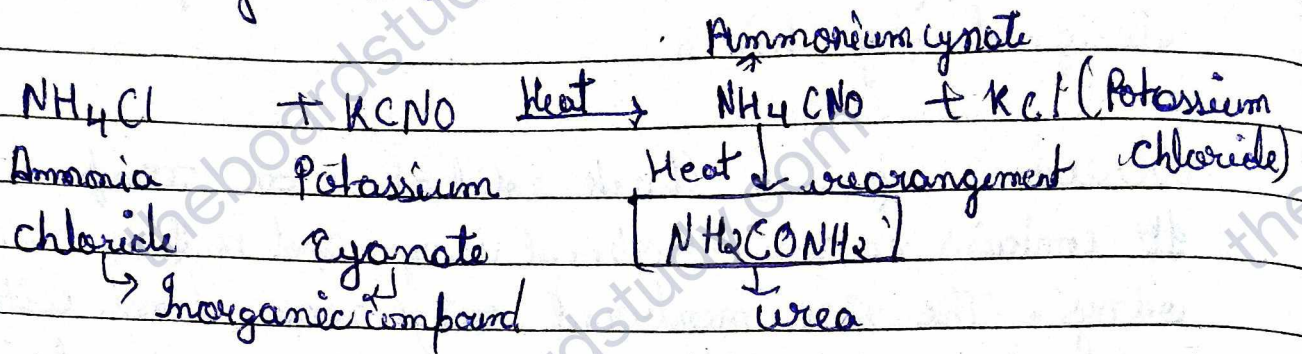
Vital force theory.

Berzelius, a Swedish chemist in 1815, proposed that organic compounds are produced only the influence of some mysterious force existing in the living organism. This mysterious force was called vital force.

Wohler's synthesis.

In 1828, Friedrich Wohler, a German chemist made an interesting discovery. He accidentally prepared urea, a well known organic compound isolated from

urine of humans and other mammals



Death Below the NBT

As an organic compound i.e. urea was formed from aqueous solutions of two inorganic compounds, it was clearly demonstrated that no mysterious force was required in the formation of organic compounds.

Introduction to saturated and unsaturated Hydrocarbon

	Alkane	Alkene	Alkyne
General formula	$\text{C}_n\text{H}_{2n+2}$	C_nH_{2n}	$\text{C}_n\text{H}_{2n-2}$
(Defined for one double and triple bond in a Hydrocarbon)	(Haloms are more than twice the no. of C atom)	(Haloms are twice less than twice the no. of C atom)	(Haloms are twice less than twice the no. of C atom)

covalent bond	single covalent bond	single bond	one triple covalent bond
btw C atoms	btw & all C atoms	- double bond	btw C atoms in a long hydrocarbon

type of hydrocarbon -	saturated	Chain	unsaturated
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suffix added	ane	ene	yne
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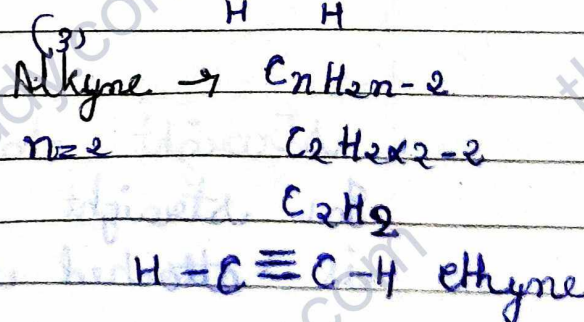
What is Saturated and unsaturated Hydrocarbon?

Saturated Hydrocarbon: Carbon atoms are saturated with maximum number of hydrogen atoms due to which no multiple bonds (double/triple) are present between carbon atoms.

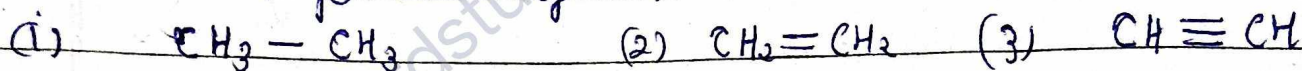
Unsaturated hydrocarbon: Carbon atoms are not saturated with multiple maximum number of hydrogen atoms due to which multiple bonds (double/triple) are present b/w carbon atoms.

Chain length of or No. of C atoms	Root word	Root word + suffix
C ₁	Meth	Alkane ⁽¹⁾ → C _n H _{2n+2}
C ₂	Eth	n=2 C ₂ H _{2×2+2} C ₂ H ₆
C ₃	Prop	Ethane
C ₄	But	H—C—C—H H H
C ₅	Pent	
C ₆	Hex	Alkene ⁽²⁾ → C _n H _{2n}
C ₇	Hept	n=2 C ₂ H _{2×2}
C ₈	Oct	C ₂ H ₄
C ₉	Non	Ethene
C ₁₀	Dec	H—C=C—H H H

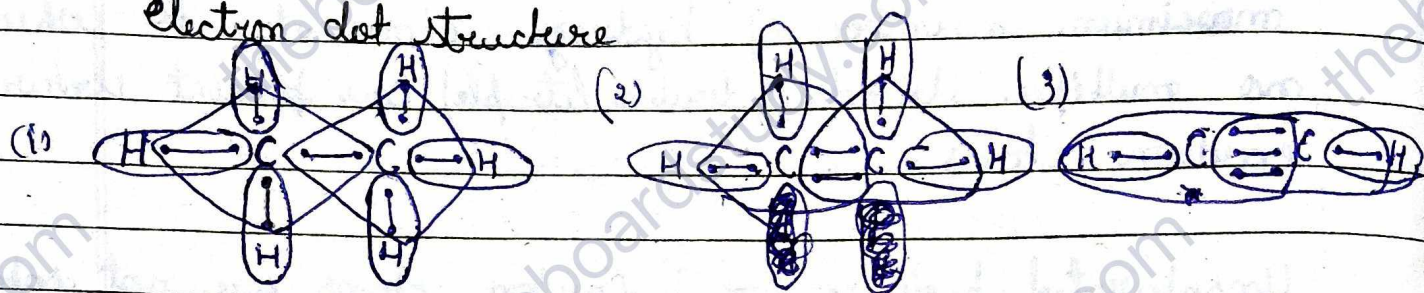
The first member of alkene and alkyne family is ethene and ethyne because minimum 2 C atoms are required for a double/triple covalent bond.



Condensed formula of 1, 2 and 3



Electron dot structure



Why methane is a saturated hydrocarbon?

Methane is a saturated hydrocarbon because:

- C is saturated with maximum number of H atoms.
- No multiple bonds like double / triple bonds are present.
- follows the general formula of alkanes.

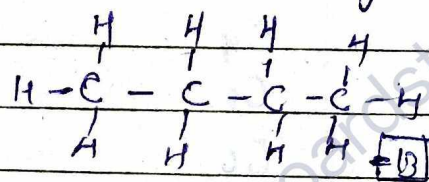
Trick to calculate number of covalent bonds.

Alkanes $\rightarrow \text{No. of C} + \text{no. of H} - 1$

$\text{C}_4\text{H}_{10} \quad 4 + 10 - 1$

13

Manual counting.



Alkenes $\rightarrow \text{No. of C} + \text{No. of H}$

$\text{C}_4\text{H}_8 \quad 4 + 8 = 12$

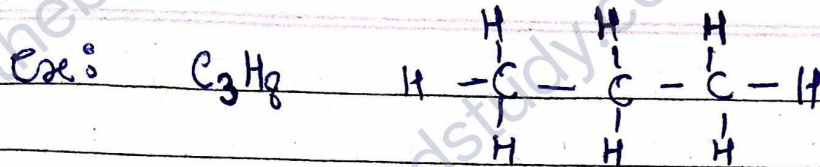
Alkyne $\rightarrow \text{No. of C} + \text{No. of H} + 1$

$\text{C}_4\text{H}_6 \quad 4 + 6 + 1$

11

Straight chain Branched and cyclic hydrocarbons.

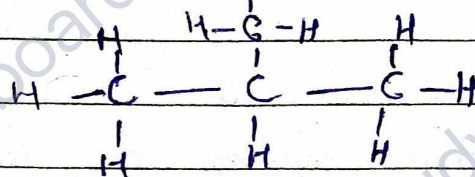
In straight chains of hydrocarbons, carbon is attached to either one or two other carbons.



Branch chain Hydrocarbons

In branched chain hydrocarbons, carbon is attached to either one, two or more than two other C atoms.

ex:- C_4H_{10}



Cyclic chain hydrocarbons

Saturated cyclic carbon compounds

cycloalkane

General formula $\rightarrow C_nH_{2n}$
Similar to alkene

Unsaturated cyclic carbon compound

cycloalkene

C_nH_{2n-2} similar to alkyne

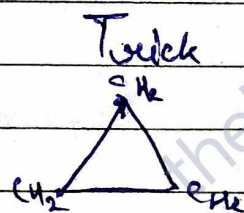
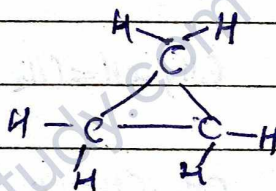
cycloalkyne

C_nH_{2n-4}

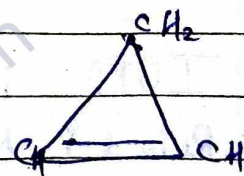
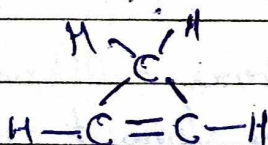
Structure

ex:-

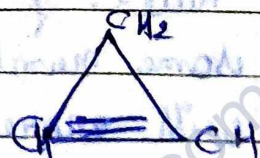
Cyclopropane $\rightarrow C_3H_6$
($n=3$)



Cyclopropene $\rightarrow C_3H_4$



Cyclopropyne $\rightarrow C_3H_2$



benzene

Common / Trivial Nomenclature

- In this system, the names were given after the source from which the organic compounds were first isolated.
- International Union of pure and applied chemistry was founded in 1919 which creates rules to write name of elements compounds and molecules in a systematic manner

IUPAC Nomenclature of Hydrocarbon.

Bond line Notation

Ex: Propane (C_3H_8) $\overset{C.P}{CH_3}-CH_2-CH_3$  or 

Propene (C_3H_6) $CH_3-CH=CH_2$  or 

Propyne (C_3H_4) $CH_3-C\equiv CH$  or 

IUPAC Nomenclature - Alkanes

- Rule 1: Select the longest carbon chain containing $=$ or $\equiv$ bond
- Rule 2: If there are multiple longest c chains containing same number of c atoms, we will select the one with more no. of substituents or branches or side chain

General formula
Alkyl group $\rightarrow C_n H_{2n+1}$

Substituent / side chain / branch

$n=1$

Main C chain

CH_3

Methyl

- Rule III: we will start numbering in such a way that
- $\rightarrow$ the 'substituent chain' gets the lowest number.
 - count left to right or right to left.
 - $\rightarrow$ if first locant rule is same then apply lowest sum rule

Rule IV: Prefix + Root word + Primary suffix

Prefix: substituent / branch / side chain $\rightarrow$ alkyl

Root word: no. of C atoms in main C chain

Primary suffix: -ane, -ene, -yne

Other rules: (i) some substituents

2 - di	4 - tetra
3 - tri	use for some substituents

(ii) Number - letter
number, number
letter, letter

* While writing the name of different substituents (alkyl) we always need to write them in order of their alphabetical order. It means alphabetisation or alphabetical rule applies everywhere.

IUPAC Nomenclature of alkenes and Alkynes

All rules remain the same as in saturated hydrocarbon (alkanes) but remember to give the lowest possible number to double bond and triple bond.

'a' is added after the root word if multiple double/triple bonds are there.

Introduction to functional groups

classification: Elements with similar properties are also classified in groups (vertical columns) and this makes their study easier.

→ classification of organic compounds is based on their physical and chemical properties.

→ The physical and chemical properties of organic compounds come from their structural features.

Heteroatom / functional group → provides function

Different atom other than H & C in hydrocarbon

Physical & chemical properties of a compound.

Hydrogen atom/atoms can be replaced by any other elements like Cl, S, N, O and provides completely different properties regardless of the length and the nature of C chain.

Hetero atom

F/Cl Br/I

Oxygen

class of compounds.

Halo-chloro/ bromo alkane

alcohol

1 O2 atom

2. Aldehyde	1 O ₂ atom
3. Ketone	1 O ₂ atom
4. Carboxylic acid	2 O ₂ atom
5. Ester	2 O ₂ atom

These different chemical classes are formed because of Difference in no of oxygen atoms & arrangement of O₂ atom in compound.

Functional Group IUPAC Nomenclature

Rules to write IUPAC name of compound containing functional group -

Rule I :- Select the longest C chain containing functional group.

Rule II :- We will start numbering in such a way that the functional group gets the lowest number - first locant rule or first point of Difference rule. After functional.

Rule III :- Prefix + Rootword + Primary suffix + secondary suffix

Imp :- After 'e' of the primary suffix + secondary suffix if there is a, i, o, u, y in secondary suffix then eliminate that 'e' of the primary suffix.

Carboxylic Acid

General formula $\rightarrow$ $C_nH_{2n+1} - COOH$ or $R - COOH$
 functional group $\rightarrow$ $-COOH$ (carboxyl functional group)
 Secondary suffix $\rightarrow$ -oic acid

Ester

General formula $\rightarrow$ $C_nH_{2n+1} - \overset{\overset{O}{\parallel}}{C} - O - C_mH_{2m+1}$ or $R - C(=O) - OR'$

Functional group $\rightarrow$ $\text{--}\overset{\text{O}}{\parallel}\text{C--O--}$ Carboxylic functional group
 Secondary suffix $\rightarrow$ -oate

Aldehyde

General formula $\rightarrow$ $\text{C}_n\text{H}_{2n+1}\overset{\text{alkyl}}{\text{--}}\text{CHO}$ or R--CHO
 functional group $\rightarrow$ --CHO (aldehyde functional group)
 Secondary suffix $\rightarrow$ -al

Ketone

General formula $\rightarrow$ $\text{C}_n\text{H}_{2n+2}\text{--}\overset{\text{O}}{\parallel}\text{C--C}_m\text{H}_{2m+2}$ or $\text{R--}\overset{\text{O}}{\parallel}\text{C--R}$
 Functional group $\rightarrow$ $\text{--}\overset{\text{O}}{\parallel}\text{C--}$ carbonyl functional group
 Secondary $\rightarrow$ -one

Alcohol

General formula $\rightarrow$ $\text{C}_n\text{H}_{2n+2}\text{--OH}$ or R--OH
 functional group $\rightarrow$ --OH
 Secondary suffix $\rightarrow$ -ol

Haloalkanes

General formula $\rightarrow$ $\text{C}_n\text{H}_{2n+2}\text{--X}$ or R--X ($\text{X} : \text{F, Cl, Br, I}$)
 functional formula $\rightarrow$ $\text{--F, --Cl, --Br, --I}$
 prefix $\rightarrow$ Fluoro, chloro, Bromo, Iodo

Homologous series

In these common difference b/w the successive members of the same family is --CH_2 unit

Ex Alkane series

Alkene series

Homologue $\rightarrow$ C_2H_6

Ethane

C_2H_4

Ethene

$\text{--CH}_2\text{--}$

C_3H_8

$+\text{CH}_2$

propane

C_3H_6

$+\text{CH}_2$

$\text{--CH}_2\text{--}$

C_4H_{10}

$+\text{CH}_2$

butane

C_4H_8

$+\text{CH}_2$

classification

Homologous series

Any Two adjacent compounds differ by $-CH_2$ unit

Difference in molecular mass any two successive members $- 14 u$

All compounds in a homologous show gradual change in their physical properties with increase in molecular mass. (M. mass (M

All compounds in a homologous series show same chemical properties. BP/MP (M

Isomerism

The phenomena of having two or more different structures having different properties but same molecular formula is known as isomerism.

Isomers

Constitutional (Structural)

Chain

Position

functional

Stereo

Chain isomer

Molecular formula

C_4H_{10}

C_4H_{10}

Functional group

Alkane

Alkane

Main chain C atoms

3

4

Branched

straight

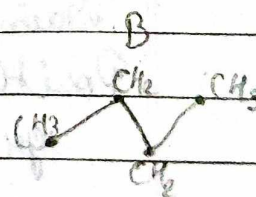
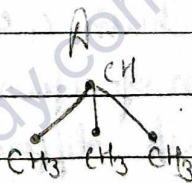
different

Common name

isobutane

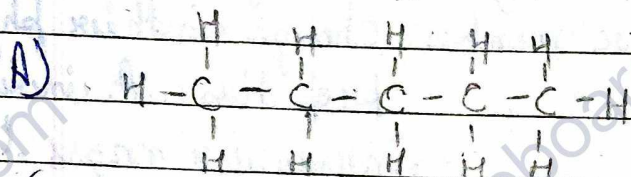
IUPAC Name n -butane 2-methylpropane

butane



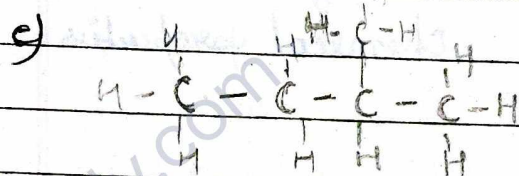
Chain Isomers

Molecular formula	A) C_5H_{12}	B) C_5H_{12}	C) C_5H_{12}
Functional group	alkane	alkane	alkane
Main chain C atoms - different	5	4	3



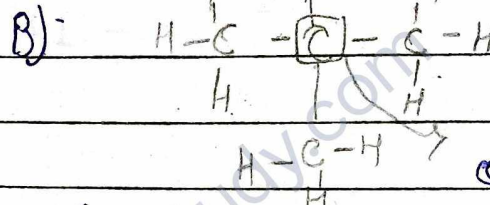
(C.N) n pentane

IUPAC $\rightarrow$ Pentane



(C.N) Iso pentane

IUPAC $\rightarrow$ 2-Methylbutane



(C.N) Neo-pentane

(C is linked to 4 other carbon)

IUPAC $\rightarrow$ 2,2-Dimethylpropane

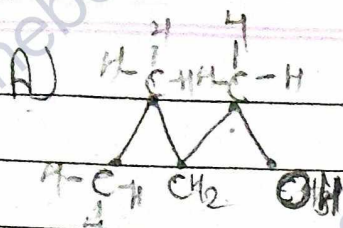
Note: n $\rightarrow$ normal no branch

iso $\rightarrow$ branch on 2nd carbon

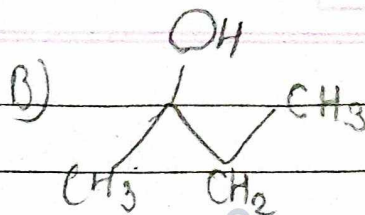
neo $\rightarrow$ Quaternary carbon (C is linked to 4 other carbon atoms)

Position Isomers

Molecular formula $\rightarrow$	A) C_4H_{10}	B) C_4H_{10}
functional group $\rightarrow$	-OH $\rightarrow$ Hydroxyl group	-OH
Main chain C atoms $\rightarrow$	4	4
Position of functional group different	on 1st C	on 2nd C



IUPAC $\rightarrow$ Butanol



But-2-ol

III Functional group Isomers

Molecular formula $\rightarrow$ Same

Main chain - C atoms $\rightarrow$ Same

functional group $\rightarrow$ Arrangement of atoms $\rightarrow$ Give rise to different functional group

Functional Group Isomers Aldehyde

General formula

$R-CHO$ or $C_nH_{2n+1}-CHO$ $\rightarrow$ $C_nH_{2n+1}-C(=O)H$

Also be written as:

$C_nH_{2n}O \rightarrow$ no. of H atoms is twice the no. of

Molecular formula

C_3H_6O

C_3H_6O

- C atoms

Main chain C atoms

3

3

functional group

Carbonyl
(Ketone)

Aldehyde

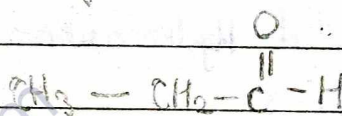
Ketone

Aldehyde



Propanone

$\rightarrow C_3H_6O$



Propanal

Functional group Isomers

Carboxylic acid

or Ester

$C_nH_{2n}O_2$

$R-COOH$ or $C_nH_{2n+1}-COOH$

$R-CO-R'$

Also be written as:

Molecular formula

$C_3H_6O_2$

$C_3H_6O_2$

Main chain C atoms

3

3

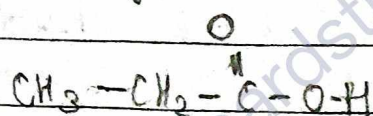
F-C

$\rightarrow$

Carboxyl

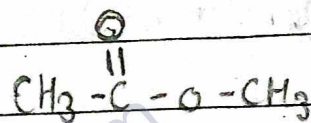
Carboxyl

Carboxylic acid



Propanoic acid

ester



Methyl ethanoate

Alcohol

G.F

$\text{C}_n\text{H}_{2n+1}\text{OH}$ or R-OH



M.F

$\text{C}_3\text{H}_8\text{O}$

(Propanol)

Main chain atoms 3

F.G

Alcohol

Substitution reaction or displacement or Replacement Rxn of Organic compounds

Substitution rxn :- One atom or group of atoms is displaced by another atom or group of atoms without change in the rest of the molecule.

Saturated Hydrocarbon or Alkanes are also known as

paraffins

↓
little low

↓
reactivity

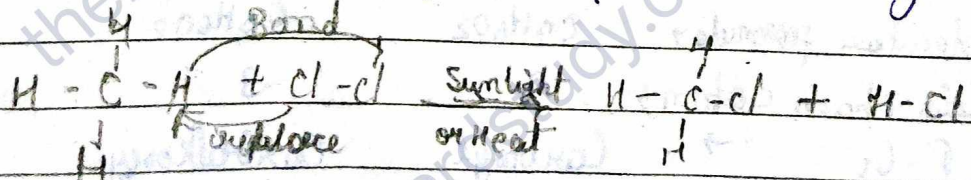
why

These compounds have single covalent bonds b/w atoms these bonds are stronger bonds.

Bonds won't break easily & that's why

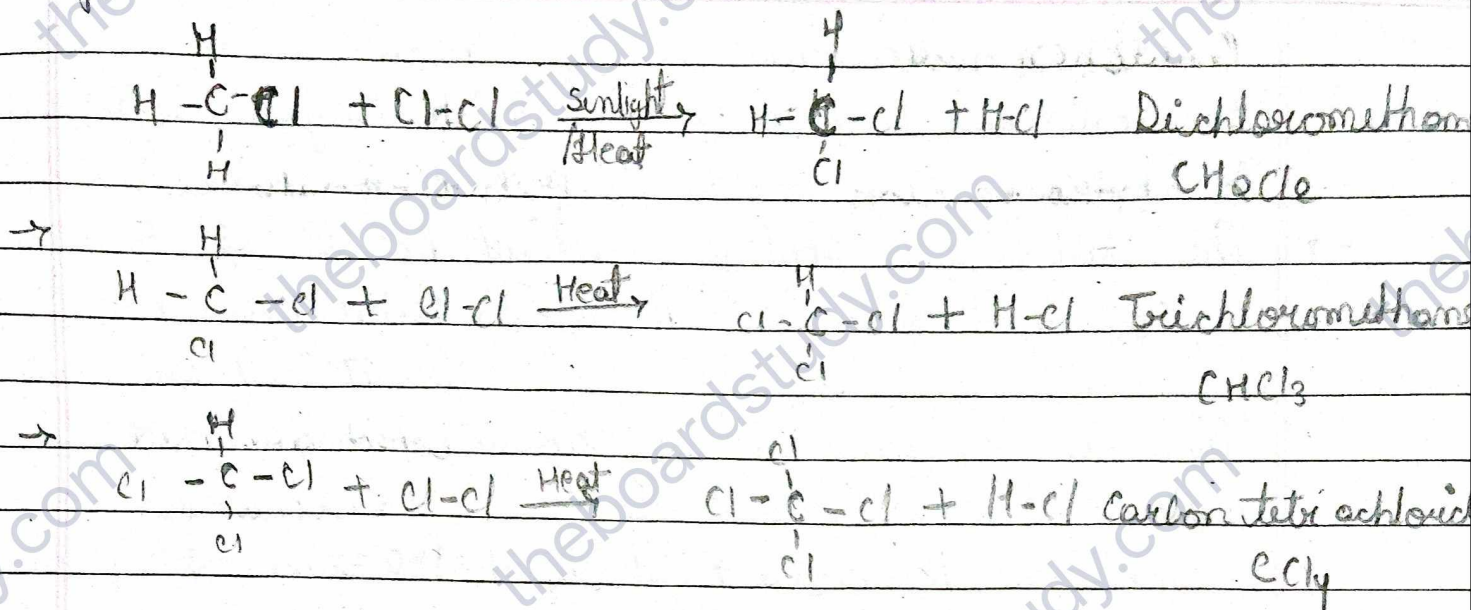
they are compounds of low reactivity.

Ex:-



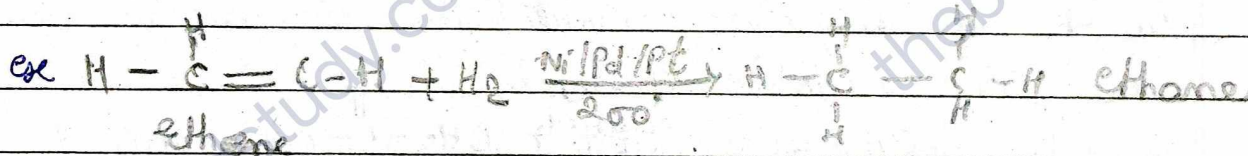
Chloro + meth + ane → chloromethane
 CH_3Cl

further reaction



Additional reaction / combination of organic compounds when an unsaturated hydrocarbon combines with (Hydrogen, bromine, etc) to give a single product in the presence of a catalyst and heat

Ni/Pb / Pt increases speed of rxn
+ve catalyst



when vegetable oil is heated in the presence of hydrogen and catalysts like Ni/Pb/Pt at 423K / 200°C then vanaspathi ghee is formed.

Need for catalytic hydrogenation of vegetable oil to vegetable ghee → vegetable oil comes in contact with oxygen and moisture turns rancid so we convert it to vegetable ghee or to reduce rancidity.

Types of light or energy

- 1) flame $\rightarrow$ candle
- 2) burning $\rightarrow$ substance converts into vapours/gaseous forms
- 3) Smouldering $\rightarrow$ Incense stick
- 4) Glow $\rightarrow$ flameless form of combustion

Combustion reaction

Hydrocarbon + ~~water~~ oxygen $\rightarrow$ Carbon dioxide + water vapour + heat + light

Natural gas $\rightarrow$ Majorly methane + ethane + propane etc.

Complete combustion

(Good amount of oxygen) $\rightarrow$ $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g}) + \text{heat} + \text{light}$

Incomplete combustion

(Lack of O_2) $\rightarrow$ $2\text{CH}_4 + 3\text{O}_2 \rightarrow 2\text{CO} + 4\text{H}_2\text{O} + \text{A} + \text{light}$

With even less oxygen $\rightarrow$ $\text{CH}_4 + \text{O}_2 \rightarrow \text{C} + 2\text{H}_2\text{O} + \text{heat} + \text{light}$
 $\downarrow$
unburnt C

Combustion Reaction (contd.)

Types of flames - on the basis of amount of light produced

① Luminous flame
produces enough amount
of yellow light

② Non-luminous flame
does not produce enough
amount of light
 $\rightarrow$ Produces Blue light

Saturated hydrocarbon

Good amount of O_2
 $\downarrow$
complete combustion

clean blue flame

ex. LPG (Butane + Propane)

Lack of oxygen

Incomplete combustion

$\downarrow$
CO

$\downarrow$
unburnt C

Crises yellow $\leftarrow$ Becomes
 colour of the flame hot and glows
 and leaves as soot (Black ~~thick~~ smoke)

$\rightarrow$ Unsaturated Hydrocarbons $\rightarrow$ always burn with a
 yellow flame (unburnt c).

Important carbon compounds - Ethanol and Ethanoic Acid.

Physical property	Ethanol	Ethanoic acid
	$\text{CH}_3\text{CH}_2\text{OH}$ / $\text{C}_2\text{H}_5\text{OH}$	CH_3COOH / $\text{C}_2\text{H}_4\text{O}_2$
Physical state,	Liquid, -114°C	Liquid, 17°C and
M.P and B.P	and 78°C	118°C .
Smell & taste	Sweet smell and burning taste	Pungent smell and sour taste
Solubility in water	Miscible in water in all proportion	Miscible in water in all proportion.
Action on Blue Litmus paper	No change in colour of red/blue litmus paper	changes colour of blue litmus to red

Uses of ethanol

- 1) used to make rectified spirit (95% ethanol / 5% water)
- 2) used to manufacture paint, medicine, dye, perfume
 Varnish etc $\rightarrow$ polish on wooden items that protects them
- 3) used to make blended petrol
 Ethanol on combustion $\rightarrow \text{CO}_2$ & H_2O $\rightarrow$ [Don't harm the
 combustion of petrol $\rightarrow \text{NO}_2$, SO_2 , CO , etc. nature that much]
- 4) an Active ingredient of all alcoholic drinks like
 beer, whisky etc.

→ When acetic acid / ethanoic acid is cooled below 17°C it forms glacier-like crystals and hence known as glacial acetic acid.

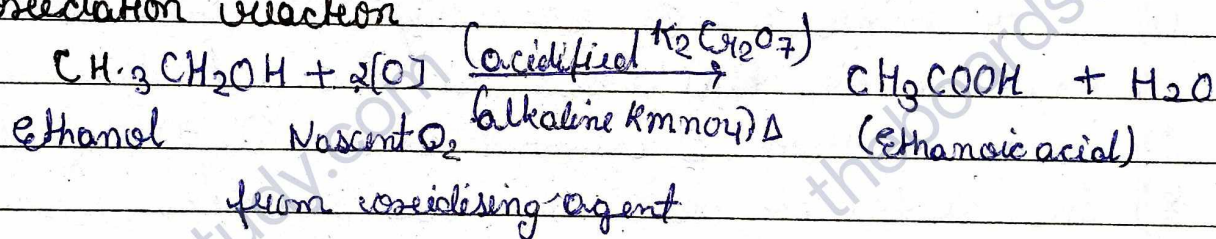
Why denaturated alcohol or methanol $\rightarrow \text{CH}_3\text{OH}$ are unfit for drinking?

→ Methanol (CH_3OH) is oxidised to methanal (HCHO) inside the liver. Methanol reacts rapidly with the components of cells and coagulate (solid) the protoplasm (nucleus and cytoplasm).

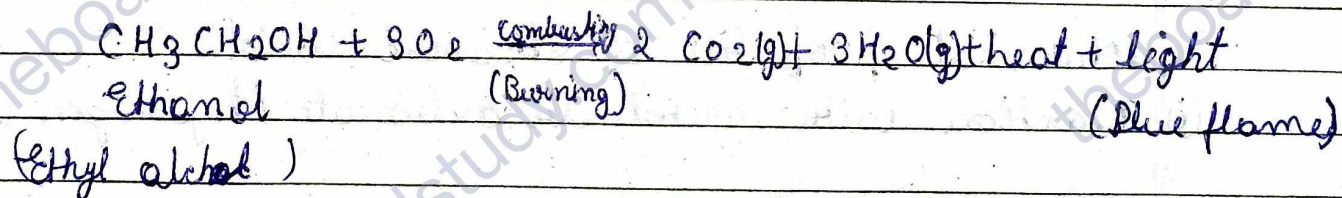
→ Methanol also affects the optic nerve, causing blindness.

Chemical Properties of Ethanol

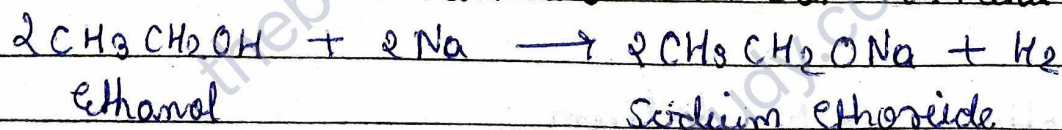
(i) Oxidation reaction



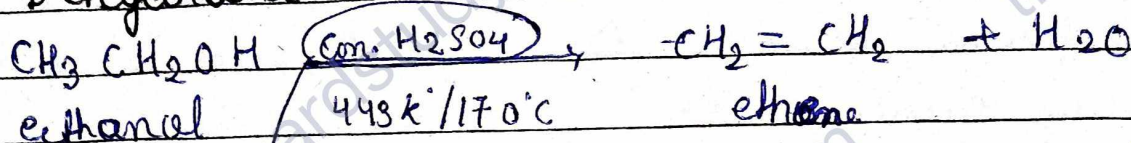
(ii) Combustion reaction :-



(iii) Reaction with sodium metal or Metal - Non metal displacement reaction



(iv) Dehydration reaction



dehydrating agent $\rightarrow$ chemically takes out H_2O from a substance

Tests for alcohol

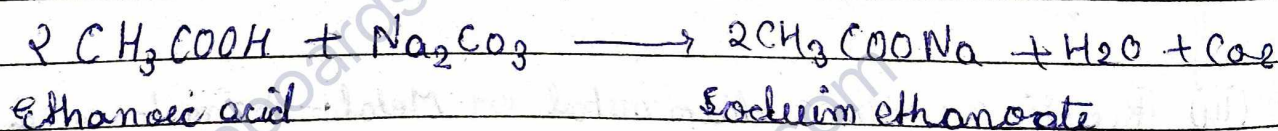
- 1) Sodium metal test: Add a small piece of sodium metal to the organic liquid (to be tested); taken in a dry test tube. If bubbles (or effervescence) of hydrogen gas are produced, it indicates that the given organic liquid is an alcohol.

Effects of alcohol on the body

- (i) liver damage
- (ii) vomiting
- (iii) increased blood flow
- (iv) rapid heat loss
- (v) increased stress on kidneys
- (vi) blurred vision
- (vii) slurred speech
- (viii) loss of coordination
- (ix) Increased heart rate & blood pressure
- (x) Reduced inhibitors $\rightarrow$ no control on sexual desires.

Chemical properties of Ethanoic Acid

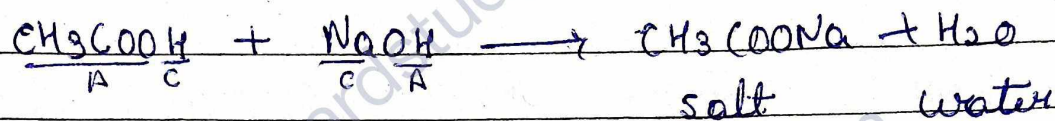
- (i) Reaction with metal bicarbonate / hydrogen carbonate



- (ii) Reaction with sodium



(iii) Reaction with base



Neutralisation R^{H^n}

Uses of Ethanoic Acid

- (i) Used to manufacture cellulose acetate i.e. rayon.
- (ii) used to manufacture acetone (propanone), dyes, perfumes etc.
- (iii) used to make vinegar (diluted form of acetic / ethanoic acid).
5-8% solution of acetic acid in water is called vinegar and is used widely as a preservative in pickles.

Tests for carboxylic Acids

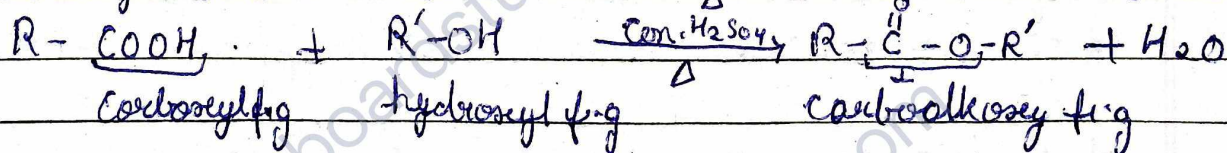
- i) Sodium hydrogencarbonates test: The organic compound is shaken in a test tube and a pinch of sodium hydrogencarbonate is added to it. evolution of carbon dioxide gas with brisk effervescence shows that the given organic compound is a carboxylic acid.

Esterification reaction

Esters are sweet smelling liquids.

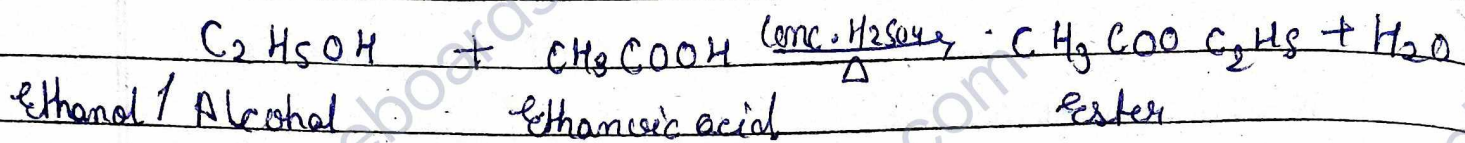
The fragrance in flowers and fruits is largely due to esters.

Carboxylic acid + Alcohol $\xrightarrow[\Delta]{\text{conc. H}_2\text{SO}_4}$ Ester + Water



where $\text{conc. H}_2\text{SO}_4 \rightarrow$ dehydration & +ve catalyst
(↑ the speed of rxn)

NCERT verⁿ



Ester are used in making : perfumes and flavouring agents

Saponification Reaction

Hydrolysis of ester (Break down of water)

$\text{R} - \overset{\text{O}}{\parallel} \text{C} - \text{O} - \text{R}'$ alkyl group is a poor

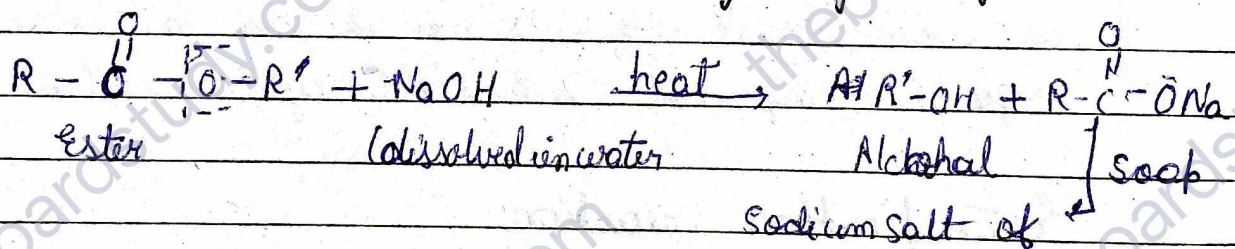
To Remove leaving group

Acidic Hydrolysis of ester $\rightarrow$ Reverse of esterification

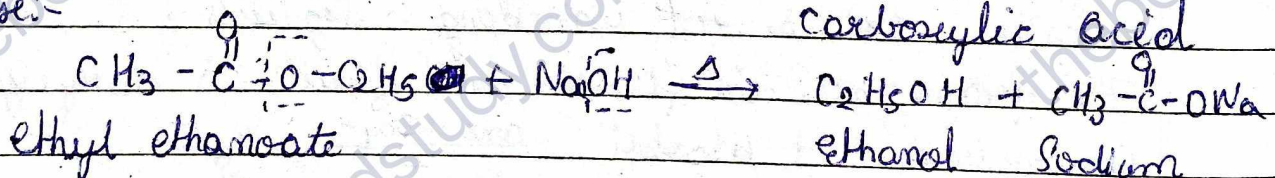
$\rightarrow$ Alkaline Hydrolysis of ester

Saponification verⁿ

Saponification reaction - Alkaline hydrolysis of ester.



NCERT Ex:



Ex: $\text{C}_{17}\text{H}_{35}\text{COONa}$ Sodium stearate (soap) Ethanoate

Soaps, Detergents and cleansing Action

Cleansing Agents

① Soaps

② Detergents

- (i) Soaps $\rightarrow$ Sodium or potassium salts of long chains carboxylic acids (fatty acid) which has cleansing properties in water.

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

Sodium palmitate ($C_{15}H_{31}COO^-Na^+$)

Soap solution is basic in nature.

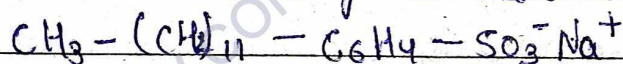
General formula $\rightarrow$ $R-\overset{\text{O}}{\underset{\text{O}^-}{\text{C}}}-Na^+$
Carboxylate

- (ii) Detergents are also called shopless soap because chemical composition is different from soap & cleansing action is $\sim$ soap.

Sodium salt of or potassium salt of long chain sulphonic acids

General formula $\rightarrow$ $R-\overset{\text{O}}{\underset{\text{O}^-}{\text{S}}}-Na^+$ or RSO_3Na
Sulphonate

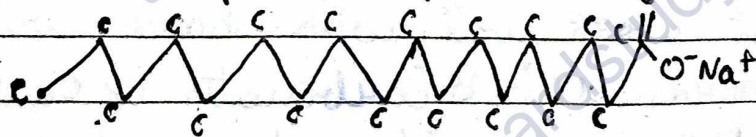
Ex: Sodium n-dodecyl benzene sulphonate



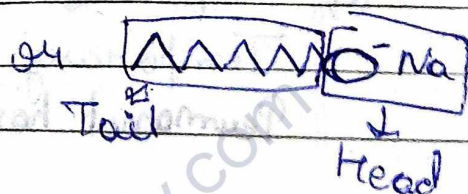
* The process of making soap by the hydrolysis of fats and oils with alkalis is called saponification.

$\rightarrow$ Manufacturing of soap: Soap is made by the hydrolysis of fats and oils with alkalis is called saponification concentrated sodium hydroxide solution (caustic soda soln).

Structure of a soap molecule



Sodium Stearate ($C_{17}H_{35}COO^-Na^+$)



Long hydrocarbon chain tail

Non polar

Soluble in oil/grease etc

Hydrophobic

water repellent

Short ionic head

Polar

Soluble in water

Hydrophilic

water love

The hydrocarbon part of the soap molecule is soluble in oil or grease, so it can ~~not~~ attach to the oil and grease particles present on dirty clothes.

The short & ionic part of the soap the soap is dissolved molecule (having negative charge) is soluble in water so it can attach to the water particles (in which the soap is dissolved and dirty cloth is dipped).

A spherical aggregate of soap molecules in the soap solution in water is called a micelle.



Spherical ionic micelle

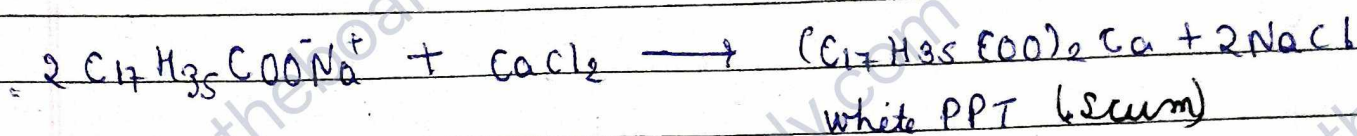
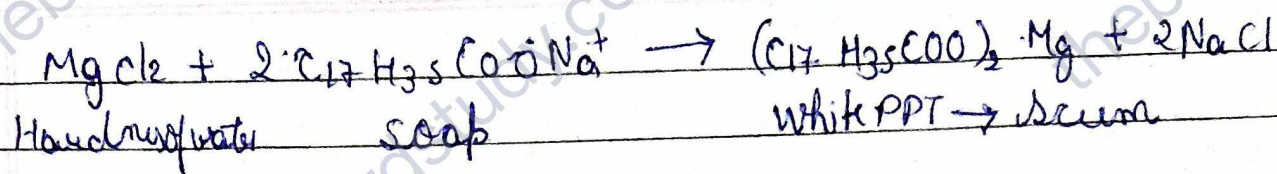
Same charge repel each other & hence ~~its~~ this cluster maintains its structure.

Advantages of Detergents over soaps

(a) Soaps do not work well with hard water

Temporary hardness :- Bicarbonates of Ca & Mg

Permanent hardness :- Chlorides and Sulphates of Ca & Mg



Scum :- Till entire hardness of water is not removed, soap will not form lather (Thap)

- b) Detergents can be used in acidic medium but soaps cannot be.

woollen clothes $\rightarrow$ Acidic dye $\rightarrow$ Detergent (w)
 $\rightarrow$ Soap (x).

Advantages of soaps over detergents:

- a) ~~the~~ soaps are 100% biodegradable while detergents are not:

- | | |
|--|--|
| ① Soaps are straight chain hydrocarbon and hence are easily decomposed by bacteria | ② Detergents are branched chain hydrocarbon and hence bacteria takes a longer time to decompose them |
|--|--|