Facts about Carbon

1.) Carbon is an element, belong to non-metals and its symbol is "C".

2.) The name 'carbon' derived from the Latin word "carbo" which means Coal — Main constituent of coal.

3.) Carbon — Fourth most abundant element in the universe.

4.) It is 15th most important element in earth's crust.

5.) It is 2nd Abundant element in human body.

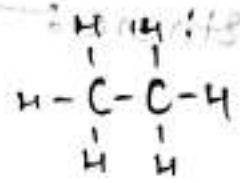
O	C	H
65%	18%	10%

6.) Carbon is found in the atmosphere (0.03%) as Carbon dioxide

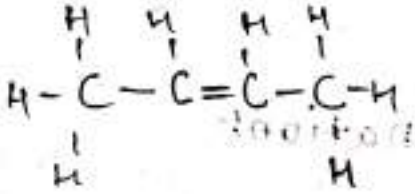
→ Formation of Covalent Bond :-

- Covalent bond is chemical bond formed by the sharing of electrons between atoms.

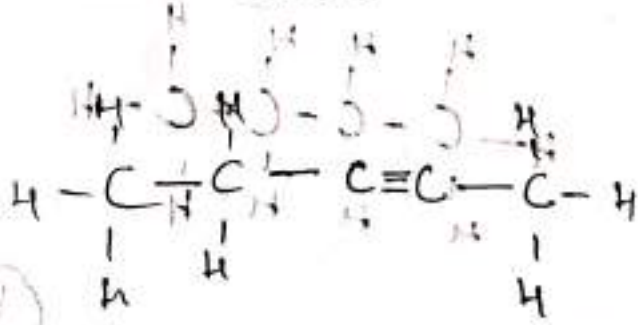
- The sharing of one pair, electrons results in the formation of single covalent bond.



- The sharing of two pairs of electrons – Double Covalent bond.

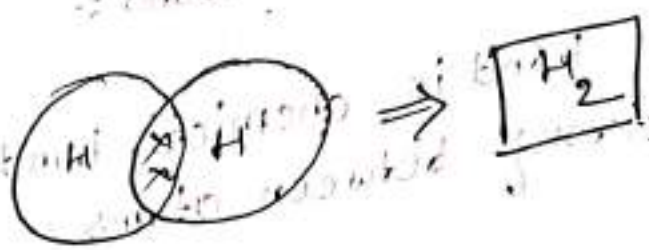


- The sharing of three pairs electrons in the formation of triple covalent bond.



Single Covalent Bond:-

1: Ethane:-



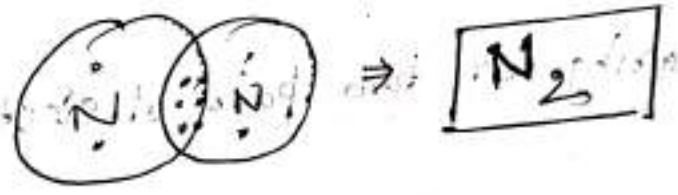
2: Double Covalent Bond:-

Ethene:-

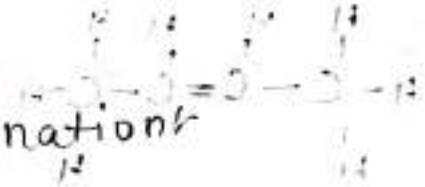
3 Triple Covalent Bond:-

Ethyne:-

4:



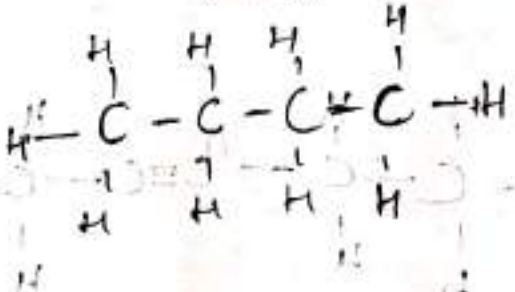
5:



→ Catenation:-

. Butane:- C_4H_{10}

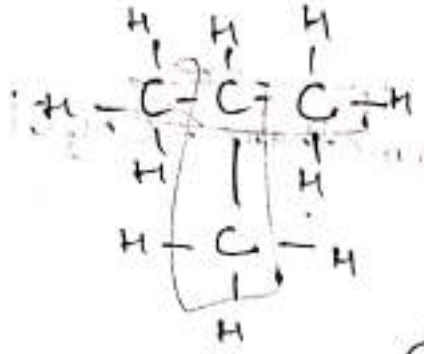
6



Long chain

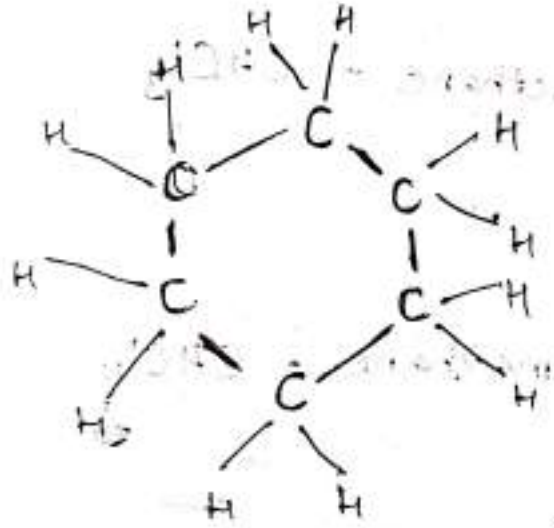
Isomers of Butane

. Iso Butane (C_4H_{10})



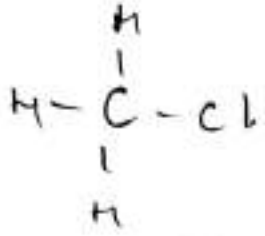
Branched Chain

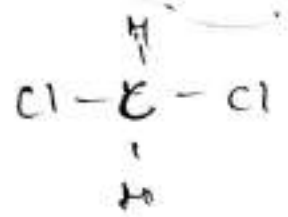
. Cyclohexane (C_6H_{12})



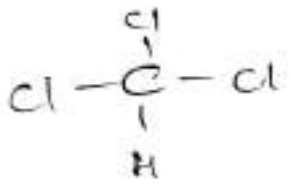
Closed Ring

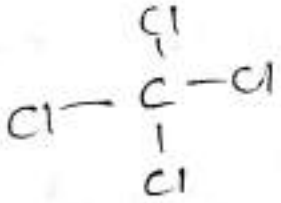
Other examples

1)  — Chloromethane - CH_3Cl

2  — dichloromethane - CH_2Cl_2

3

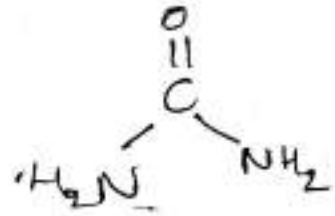
4  — trichloromethane - $CHCl_3$

5  — Tetrachloromethane - CCl_4

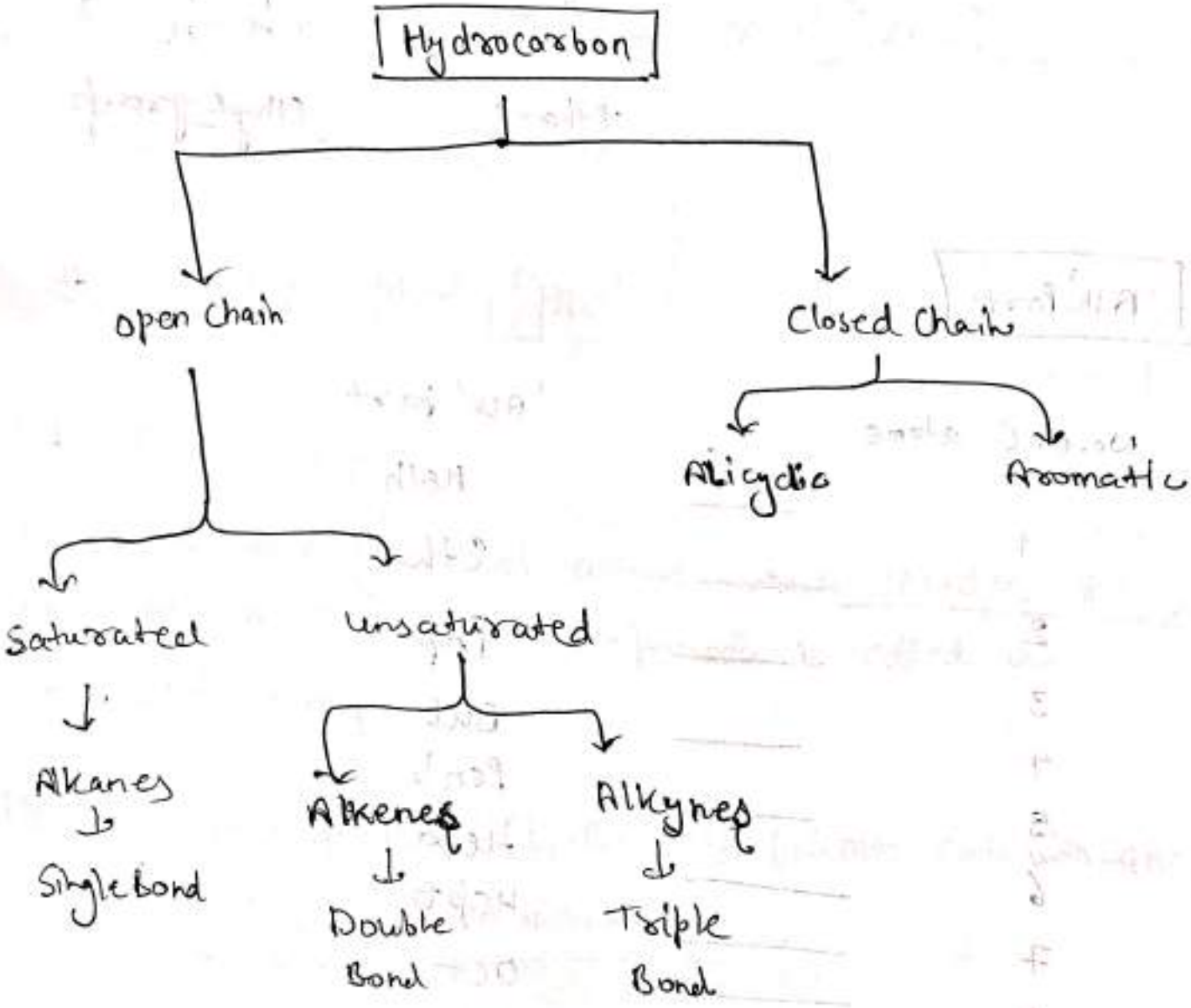
6

$S=C=S$ Carbon Disulphide :- CS_2

$O=C=O$ Carbon dioxide :- CO_2

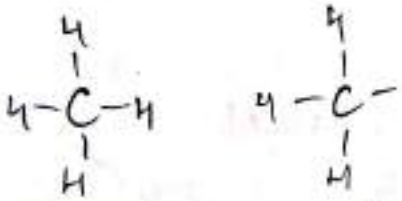
 → Urea = $CO(NH_2)_2$

classification of hydrocarbons:-

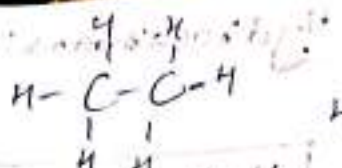


→ Alkyl Group:- The group formed by the removal of one hydrogen atom from an alkane molecule is called an Alkyl group.

Eg. Methyl group (CH_3)



Ethyl group (C_2H_5) :-



Ethane

Ethyl group

'Alk' Part

No. of C atoms	'Alk' part
1	Meth
2	Eth
3	Prop
4	But
5	Pent
6	Hex
7	Hept
8	Oct
9	Non
10	Dec

[Primary Suffix]

- If all the bonds are single bond "ane".
- If one double bond "ene".
- If one triple bond "yne".

→ Functional Groups:-

An atom or a group of atoms which decides the properties of a carbon compound is called a functional group.

i) Halide (Halo group) :- -Cl, -Br, etc. (Names ends with -ane)

e.g. - CH_3Cl :- Chloromethane.

ii) Alcohol :- -OH (end with 'ol')

e.g. - CH_3OH - Methanol

iii) Aldehyde :- -CHO or $-C(=O)H$ (Names end with 'al')

e.g. - HCHO - Methanal

iv) Carboxylic acid :- -COOH or $-C(=O)OH$ (Names end with 'oic acid')

e.g. - CH_3COOH - Ethanoic acid

iv) Ketone :- $-CO$ or $-\overset{\overset{O}{\|}}{C}-$ (Names end with -one)

e.g. - CH_3COCH_3 - Propanone

→ Homologous series :-

- Homdogus series is a group of carbon compounds having similar structure, similar chemical properties and whose successive members in differs by a $-CH_2$ group.

Homologasus Series of

Alkanes	Alkene	Alkyne
CH_4	C_2H_4	C_2H_2
C_2H_6	C_3H_6	C_3H_4
C_3H_8	C_4H_8	C_4H_6
C_4H_{10}	C_5H_{10}	C_5H_8
C_5H_{12}	C_6H_{12}	C_6H_{10}

Homologous Series of

Aldehydes	Alcohols	Carboxylic acids
$HCHO$	CH_3OH	CH_3COOH
CH_3CHO	C_2H_5OH	C_2H_5COOH
C_2H_5CHO	C_3H_7OH	C_3H_7COOH
C_3H_7CHO	C_4H_9OH	C_4H_9COOH

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Chapter-4

Carbon and its Compounds

1) Cyclopentene.

2) The molecular formula of Alkane is C_nH_{2n+2}

Molecular formula of given carbon compound, n=11 is $C_{11}H_{24}$.

3) Propanone has suffix 'one' which means it belongs to ketone functional group.

4) Covalent Bonds are formed ~~when~~ by the sharing of electron pair / pair between the atom.

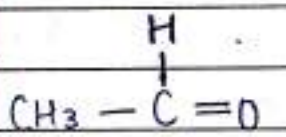
5) 2nd member :- $CH_4 + CH_2 \longrightarrow C_2H_6$ - Ethane

3rd member :- $C_2H_6 + CH_2 \longrightarrow C_3H_8$ - Propane

6) i) CH_3-CH_2-OH

The given Compound is Ethanol.

ii)



The given Compound is Ethanal.

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7.) The atomic number of carbon is 6. Electronic Configuration of carbon can be written as K = 2 and L = 4

Carbon requires 4 more electrons to attain its noble gas configuration. Carbon can acheieve electrons to fill its outermost shell in two ways :-

i.) Carbon atom can gain C^{4-} anion atom to fill its octet, but in that case nucleus with ~~four~~ six protons ~~electrons~~ cannot handle ten electrons.

ii.) Carbon atom can lose C^{4+} cation atom to fill its octet, but in that case it requires a huge amount of energy which is not possible.

Therefore, Carbon share its 4 electrons with atoms of other element and forms Covalent Bonds to exist in nature.

8.) The general formula of homologous series with functional group -OH is $C_nH_{2n+1}OH$

Two Consecutive homologous organic Compounds are :- CH_3OH (Methanol) and C_2H_5OH (Ethanol).

i.) As, the molecular mass of compound increases then in homologous series then its boiling point also increases

ii.) The solubility of organic Compounds of a homologus series decreases with the increase in molecular mass

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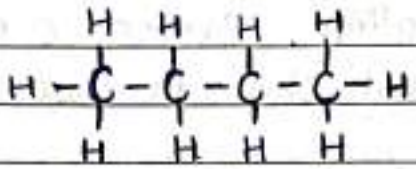
9.) i.) Saturated Compound with four carbon atoms — Butane. {C_4H_{10}}.



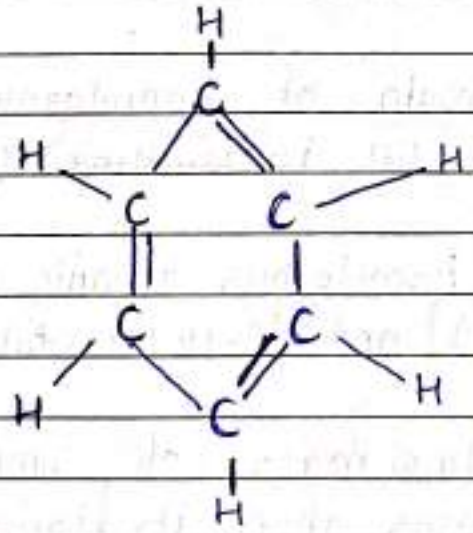
(Butane)

ii.) The number of Single Covalent Bond is 13.

10.) a.) C_3H_6 have only 1 double Covalent bond.

b.) C_2H_2 is the first member of homologous series ~~to~~ which is from alkyne family with formula. C_nH_{2n-2}

c.) C_6H_6 (Benzene) forms ring structure of carbon atoms.



(Benzene)

d.) C_3H_8 also called Propane is the member of alkane series having formula C_nH_{2n+2}.

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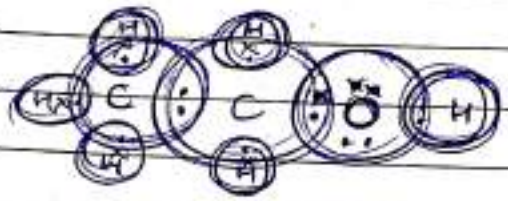
11) Element P and R will form covalent Bonds with carbon.

b) Carbon has valency of four or tetravalent ~~this property~~ and property of Catenation.

12 a) Ethanol : C_2H_5OH



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b) Homologous of A are

CH_3OH and C_3H_7OH

13) - Burn a compound in the presence of air/oxygen and pass out the gas evolved during reaction through lime stone which will be turns milky.

- By sharing its four valence electrons with other carbon atoms or element to form covalent Bond.

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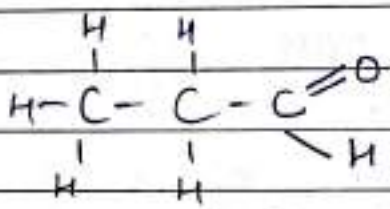
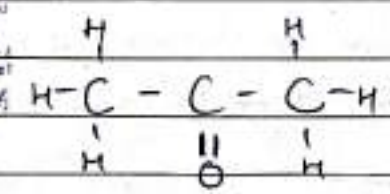
~~14.~~ ~~Propanal :- O_3~~

14. Yes, Organic Compounds belonging to different homologous series can be isomers. Such as

Propanal :- C_3H_6O



Propanone :- C_3H_6O



Both Propanal and Propanone have molecular formula C_3H_6O but their structure are different therefore they are isomers.

But, alkane and ethanol cannot be isomers because ethanol consist Alcohol functional group and alkane doesn't consist any functional group.

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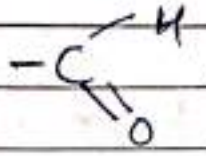
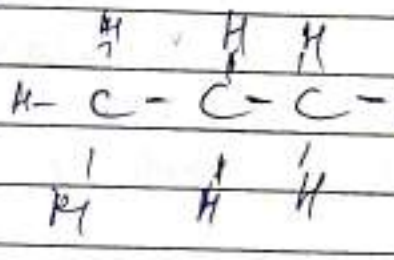
15.) (a) Aldehyde is the functional group present in these compounds



6.) General formula :- ~~$C_nH_{2n+1}O$~~ $C_nH_{2n}O$

(c) (i) forms the part of homologous series of the aldehydes as these compounds differs from each other by $-CH_2$ unit,

structure of 4th member of the series is :-



(C_4H_8O)

16.) (a) Ethyne = C_2H_2

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(b) Difference between Ionic & Covalent bonds

Ionic	Covalent
Generally	
i.) It conducts electricity	i.) Generally, It doesn't conduct electricity
ii.) they have high melting & boiling points	ii.) They have low melting & boiling points

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17.) Concept :- Same functional group = Similar Chemical properties

a.) Q & S have similar chemical properties because they belong to same functional group - Alcohol.

b.) None of them have same boiling point because all are different chemical substances.

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Chapter-4

Carbon and its Compounds

Important Reactions:-

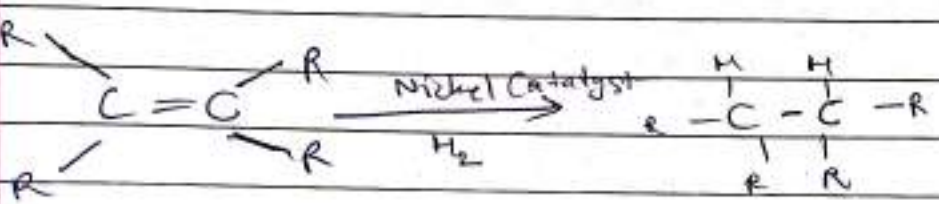
i) $C + O_2 \longrightarrow CO_2 + heat + light$

ii) $CH_4 + O_2 \rightarrow CO_2 + H_2O + heat + light$

iii) $CH_3CH_2OH + O_2 \rightarrow CO_2 + H_2O + Heat \& light$

iv) $CH_3 - CH_2OH \xrightarrow[\text{or Acidified } K_2Cr_2O_7 + \Delta]{\text{Alkaline } KMnO_4 + Heat} CH_3COOH$

{Ethanol} {Ethanoic Acid}

v) 

vi) $CH_4 + Cl_2 \longrightarrow CH_3Cl + HCl$ (in the presence of Sunlight)

vii) $2Na + 2CH_3CH_2OH \rightarrow 2CH_3CH_2O\text{-}Na^+ + H_2$
(Sodium Ethoxide)

viii) $CH_3 - CH_2OH \xrightarrow[H_2SO_4]{Hot\ Conc.} CH_2 = CH_2 + H_2O$

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ix) $CH_3-COOH + CH_3-CH_2OH \xrightleftharpoons{Acid} CH_3-\underset{\underset{O}{\|}}{C}-O-CH_2-CH_3 + H_2O$

{Ethanoic acid} {Ethanol} {Ester}

x) $CH_3COOC_2H_5 \xrightarrow{NaOH} C_2H_5OH + CH_3COONa$

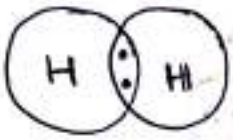
xi) $NaOH + CH_3COOH \longrightarrow CH_3COONa + H_2O$

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

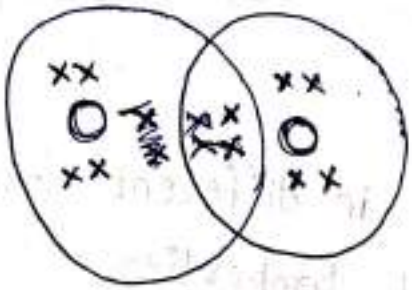
xiii) $CH_3COOH + NaHCO_3 \longrightarrow CH_3COONa + H_2O + CO_2$

Ch-4

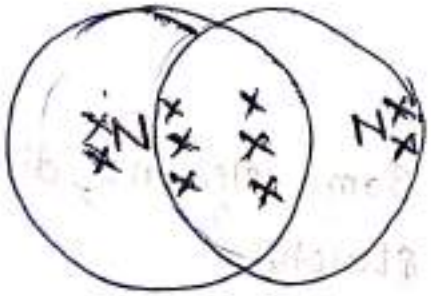
Carbon and its Compounds



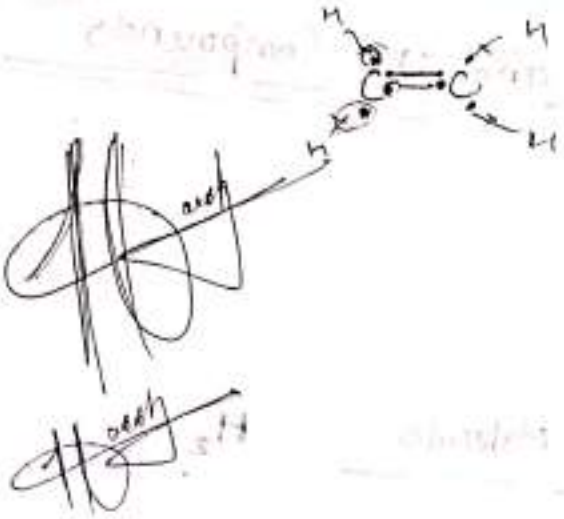
Hydrogen Molecule H_2

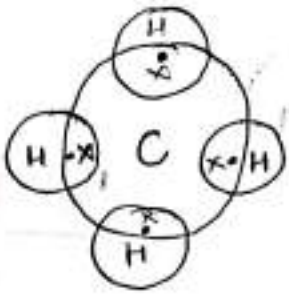


Oxygen Molecule O_2



Nitrogen Molecule N_3





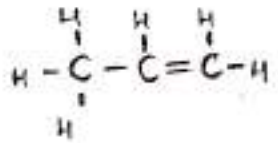
Allotropes of Carbon:-

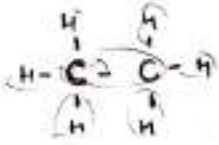
The element carbon occurs in different forms in nature with widely varying physical properties.

Allotropes :- Same element, different physical structure

$C_n H_{2n}$

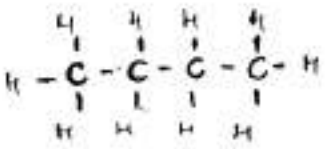
C_3H_6





$C_n H_{2n+2}$

$C_4 H_{10}$

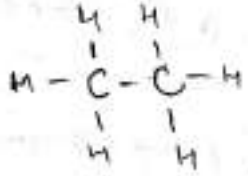


Ethane :- C_nH_{2n+2} = C_2H_6

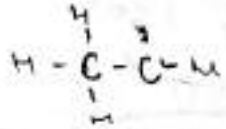
Ethene :- C_nH_{2n} = C_2H_4

Ethyne :- C_nH_{2n-2} = C_2H_2

Ethane :-



Ethene :-



→ Uses of Ethanol :

i) Used to make rectified spirit (95% ethanol and 5% water)

ii) Used to manufacture paints, medicine, dye, perfume, varnish etc.

iii) Used to make blended petrol (₹5 - ₹100)

Petrol + Ethanol → solvent to mix them → Benzene

₹5 ⇒ 5% Ethanol + 95% Petrol.

Blended Petrol → combustion → $CO_2 + H_2O$ + heat + light which has lower pollutants than petrol.

→ Chemical properties of Ethanoic Acid :-

i) Esterification Reaction → Ester → fruity smell compounds

+ve Catalyst (Increase speed of Reaction)

→ Takes out H_2O

$$CH_3 \cdot COOH\ (aq) + CH_3CH_2OH \xrightarrow{\text{Conc. } H_2SO_4} CH_3COOC_2H_5\ (aq) + H_2O\ (l)$$

Ethyl ethanoate (Ester)

Saponification Reaction:- Preparation of Soap

$CH_3COOC_2H_5 + NaOH \rightarrow C_2H_5OH + CH_3COONa$

Ester — Sodium Hydroxide — Ethanol — Sodium acetate / sodium ethanoate

Reaction with Metal carbonate and Metal hydrogen carbonate:

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

Sodium ethanoate

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

Sodium ethanoate

→ Uses:-

i) Used to manufacture cellulose acetate, i.e. rayon

ii) Used to manfacture acetones, dyes, perfume etc.

iii) Used to make vinegar (diluted form of acetic / ethanoic acid) 5-8% solution of acetic acid is added to water to form vinegar (sirka).

Soaps & Detergents :-

Cleansing Agents :- ⟶ Detergents

Soaps

Sodium or potassium salts of long chain carboxylic acids (fatty acids)

$C_{17}H_{35}COOH$ {stearic acid}

General Formula : $R-\overset{O}{\overset{\|}{C}}-O^{-}-Na^{+}$

Soapless Soap

Chemical Composition is different

Sodium salt of long chain sulphonic acids

Cleansing

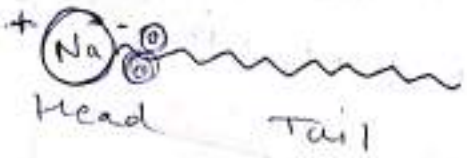
General Formula

$R-S(=O)(=O)-O-Na^{+}$

or

RSO_3Na

Structure of Soap Molecule

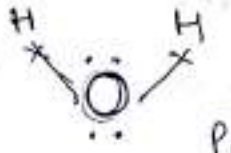


Short Ionic head

↓

Polar — Having poles (+ve and -ve charges)

↓

Soluble in water (Polar) → 

Partial Negative and Positive due to shifting of electrons

↓

Hydrophilic

water loving

→ Long hydrocarbon chain tail

↓

Non-polar

↓

Soluble in oil (non-polar)

↓

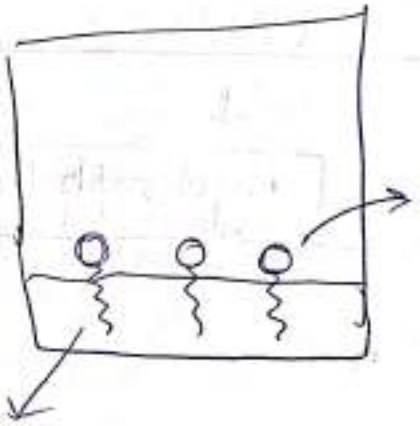
Hydrophobic

water hating

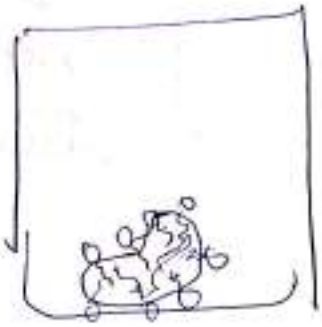
→ Cleansing Action of Soap/detergent :

(a) Soap or detergent dissolves in water

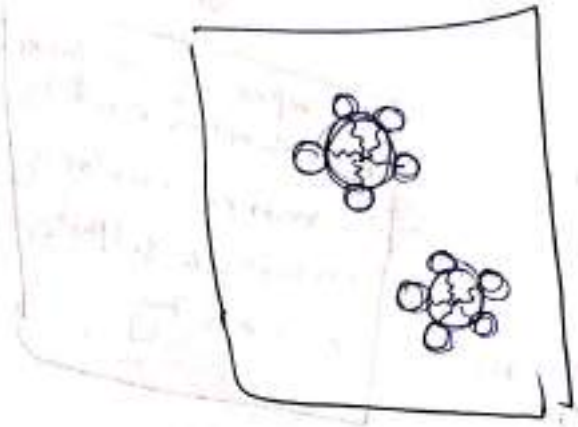
(b) Surfactant ions orientate themselves in grease and water



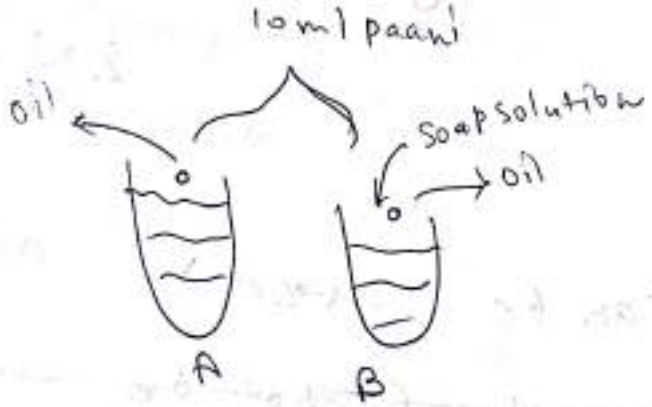
(c) Agitation begins to separate grease from surface



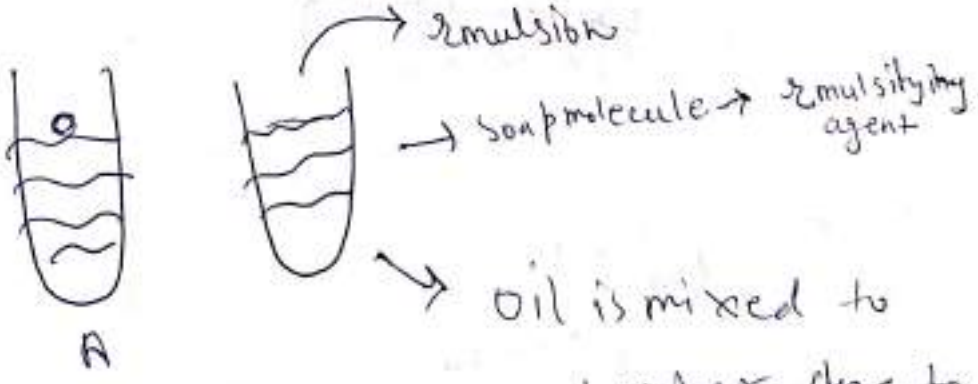
→ Cleaning complete with formation of spherical ionic micelle



Activity:-



↓ Shake vigorously & keep it for some time



Advantages of Detergents over Soaps

(a) Soaps do not work well with hard water (Lather)

↓

Detergents make lather with hard water as well

↓

→ Temporary Hardness
Bicarbonates of Ca & Mg
→ Permanent Hardness
Chlorides & Sulphides
of Ca & Mg

$$2\,C_{17}H_{35}COONa^{+} + MgCl_2 \rightarrow \underset{\text{(scum)}}{(C_{17}H_{35}COO)_2Mg} + \underset{\text{white ppt}}{} 2NaCl$$

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

Woollen Clothes → Acidic dyes → Detergent
→ Soap (X)

Advantages of soaps over Detergents

a) Soaps are 100% biodegradable detergents are not.