

Organic compound

Organic Compounds:

> Organic compounds that are plant and animal origin.

example:- acetic acid (vinger), alcohol (wine), tartaric acid (grapes).

> Organic compounds are hydrocarbons and their derivatives.

example: ethane, benzene, carboxylic acid, esters etc.

Inorganic Compounds:-

> Inorganic compounds are mineral origin.

example: salt, marble, CO_2 .

> Inorganic compounds are those except hydrocarbons & derivatives.

Example: CO_2 , H_2O , HCO_3^- , CS_2 etc.

Organic Chemistry:-

The branch of chemistry which deals with the study of hydrocarbons and their derivatives.

Sources of Organic Compounds:

> main source fossil fuels :-

☐ coal ☐ petroleum ☐ natural gas.

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Fractions of Petroleum :

petroleum gas, Petrol (gasoline), Naphta, Paraffin, diesel, fuel oil, lubricating oil, Bitumen.

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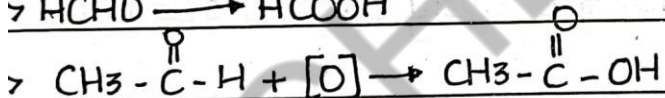
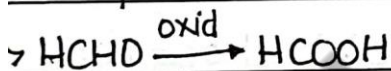
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Synthesis :

Partial synthesis

- > In this synthesis, an intermediate product of reaction is used to synthesize the required product.
- > less complex and challenging.
- > It uses intermediate or existing part of molecule.
- > used when functional groups or structural modification are needed on existing molecule.

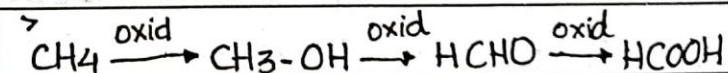
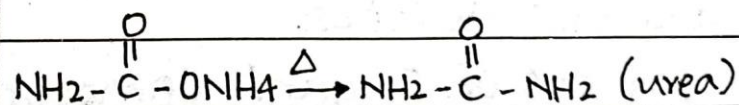
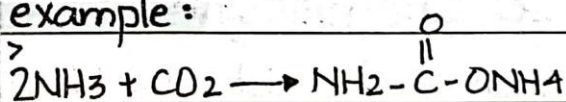
example :



Total synthesis

- > In this synthesis, the starting material is converted through many steps into target product.
- > more complex & challenging.
- > It uses multiple steps to create entire molecule from starting.
- > used for creating entirely new molecule that haven't been synthesized.

example :



- destructive distillation of coal

coal is produced by decaying trees that are buried under earth crust by influence of temperature and high pressure.

Process:-

> Coal is heated in the absence of air $\rightarrow$ temp (500-1000°C).

> Then it's converted into different substances like:

• coke • coal gas • coal tar

destructive distillation:

The breakdown or decomposition in absence of air. Also called as **Pyrolysis** and **devolatilization**.

Description of coal Products:-

1- **Coke**

> It's a solid carbon allotrope.

> Pure form of carbon.

> It's present in solid state.

> Produce 2 gases.

$H_2O \leftarrow$ water gas
(CO + H_2)

Producer gas $\rightarrow NH_3$
(CO + N_2)

> left Part used as Pitch.

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2. Coal tar

> Black thick Liquid mixture of 215 organic compound.

> By fractional distillation, it produces.

• benzene • benzole, toluene, naphthalene, anthracene, xylene • phenol
• cresol.

3. Coal gas

> Mixture of H_2 , CH_4 , CO .

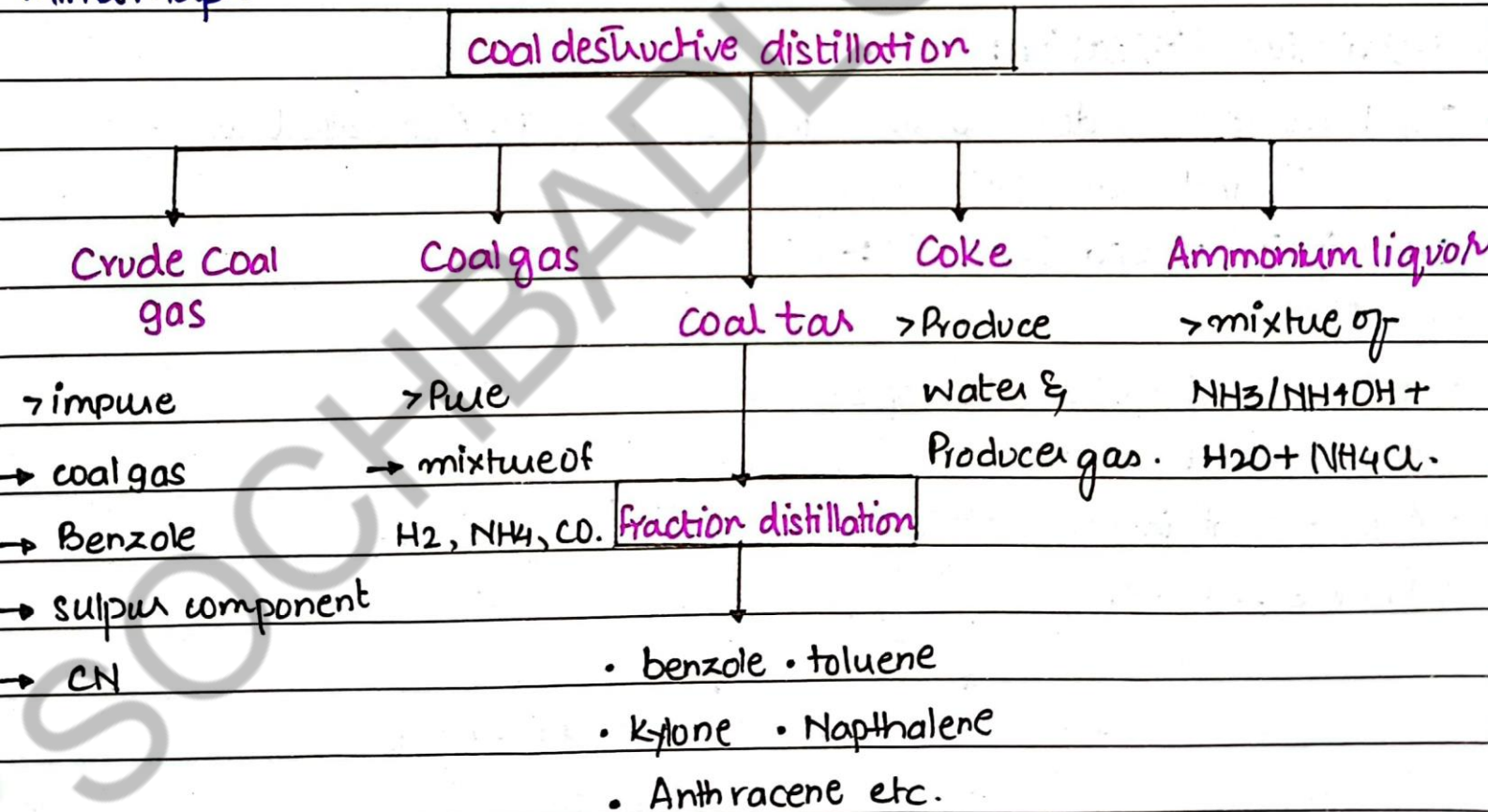
> used as fuel in industries.

4. Ammonical liquor

> Mixture of NH_3 or NH_4OH + water + NH_4Cl .

> used in fertilizer & medicines.

Mind Map :-



Fractional distillation: separation of comp by diff boiling points.



allotropes

Definition :-

Different structural forms of same elements in same physical state.

Reason :-

Due to different arrangements of atoms, physical forms of element exists.

> Physical Properties • M.P, B.P, taste, smell, density, evaporation, color, shape, thermal conductivity, electrical conductivity, volume, refractive index.

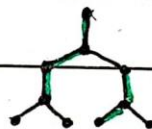
allotropes of Carbon:

There are 3 allotropes of Carbon :-

diamond :-

> $1C = 4C$

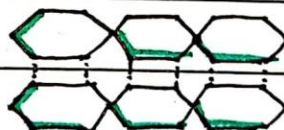
> tetrahedral



Graphite :-

> $1C = 3C$

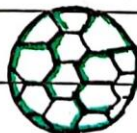
> hexagonal



Bucky ball :-

> $1C = 3C$

> ball shaped or football



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Bucky Ball / Fullerenes :-

1- Discovery: discovered in 1985 by Buckminster Fullerenes.

2- No. of carbon atom: contain C-atom from C_{40} - C_{100} .

Simplest bucky ball have carbon atom - 60.

3- Structure:- hollow cage like structure.

Pentagon = 12 & hexagon = 20.

4- Bonding: $C_1 = C_3$.

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5- Uses:- lubricant, semi-conductor, to store hydrogen, serves as drug delivery, imaging agents, performance in solar cells etc.

functional group

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Definition:- A functional group is an atom or group of atoms in a molecule that gives characteristics properties to the molecule.

- > hetero-atoms form functional groups.
- > The functional groups causes physical & chemical properties of molecule or compound.

change
double & Triple bonds are also functional groups.

example:- CH_4 (methane) VS $\text{CH}_3\text{-OH}$ (methanol - IUPAC & methyl alcohol - C.N)

Importance:

Functional groups undergo characteristic reactions. They hold crucial imp.

Basics of nomenclature F.G serves as basis of nomenclature of organic compounds.

chemical reactivity F.G is a site of chemical reactivity of molecule.

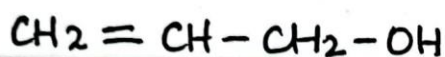
Classes F.G serves to classify O.C into classes.

Polyfunctional:-

A molecule that contains more than one functional group.

> the properties of each functional group may be modified by the presence of others.

example:-



↓
double

↓
alcohol

M.P & B.P $\propto$ No. of carbon atoms.
↳ MDCAT mcq.

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homologous series

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A series of organic compounds in which two successive members of series differ by $-CH_2$ unit or 14amu.

> Each member is called homolog.

→ Tables:

Prefix	Name			Molecular f	condensed f
	alkane	alkene	alkyne		
Meth	methane	-	-	CH ₄	CH ₄
Eth	ethane	ethene	ethyne	C ₂ H ₆	CH ₃ CH ₃
Prop	Propane	Propene	Propyne	C ₃ H ₈	CH ₃ CH ₂ CH ₃
but	butane	butene	Butyne	C ₄ H ₁₀	CH ₃ CH ₂ CH ₂ CH ₃
Pent	Pentane	Pentene	Pentyne	C ₅ H ₁₂	CH ₃ CH ₂ CH ₂ CH ₂ CH ₃
hex	hexane	hexene	hexyne	C ₆ H ₁₄	CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ CH ₃
hept	heptane	heptene	heptyne	C ₇ H ₁₆	CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₃
oct	octane	octene	octyne	C ₈ H ₁₈	CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₃
non	nonane	nonene	nonyne	C ₉ H ₂₀	CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₃
dec	decane	decene	decyne	C ₁₀ H ₂₂	CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₃

detection

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Carbon is crucial element in all organic compound. Hydrogen is also present in almost all O.C but may be replaced by S, N, O₂, P & other metals.

Part a

Carbon and hydrogen

1. Carbon and hydrogen are heated by adding small quantity of O.C.
2. Add some W.D with O.C in a glass test tube.
3. Heat this mixture.
4. Oxidation of Carbon and hydrogen occurs producing carbon dioxide & water.
5. Testing of C by CO₂ & H₂ by H₂O can be done as follows:-

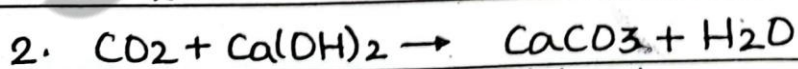
Carbon

- Take limewater that's transparent in color.
- Adding CO₂ will turn lime water color to milky white.

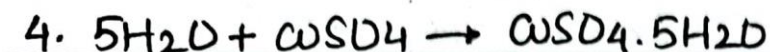
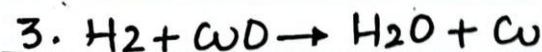
Hydrogen

- Take copper anhydrous in solid form & white in color.
- Water will change its color to blue making copper sulphate hydrate.

Reaction

Lime water
(transparent)white ppt
insolublePage # 

Teacher's Signature: _____



anhydrous hydrated
white solid blue color.

Q# Why don't CO_2 & H_2O form H_2CO_3 ?

↳ both gases are in gaseous state, gases need high pressure to make react together. Other reason is that H_2O & CO_2 will move from high temp $\rightarrow$ Low temp towards conical flask where it will be detected.

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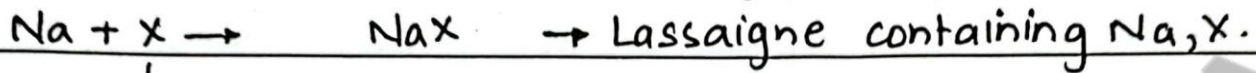
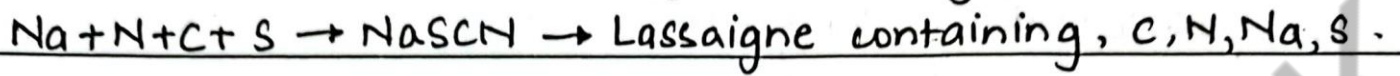
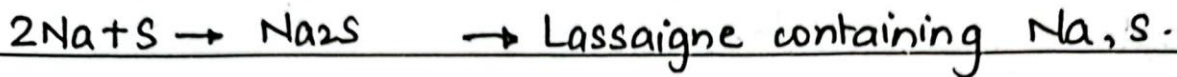
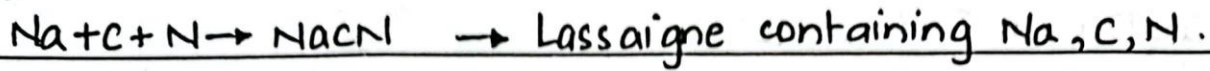
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Part b

Preparation of Lassaigne's Solution

1. Cut a small piece of sodium metal with the help of knife.
2. Put this piece of sodium metal in fusion tube.
3. Heat the fusion tube in a flame to melt sodium metal.
4. When sodium metal is melted, add small quantity of D.C.
5. Then again heat, the fusion tube till becomes hot red.
6. Break the fusion tube into china dish that contains 20cm^3 of distilled water.
7. Mix all mixture then boil it & filter the solution.
8. This filtrate is called Lassaigne's solution or sodium extract.
9. Divide this filtrate into 3 portions to test following.

Equation



↳ Cl, Br, I.

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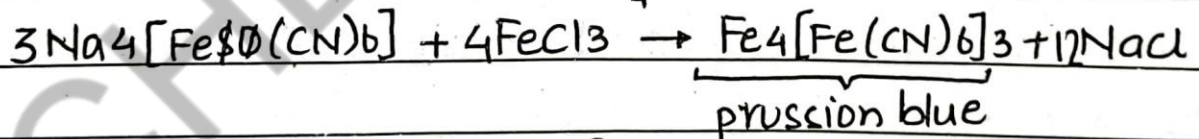
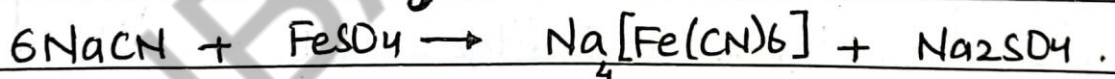
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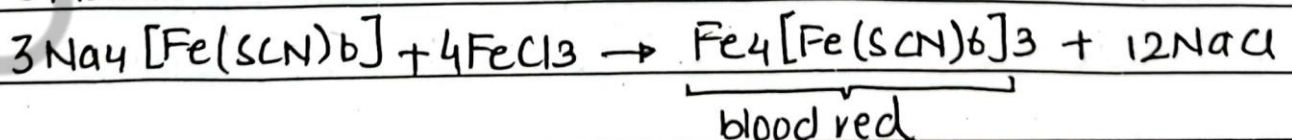
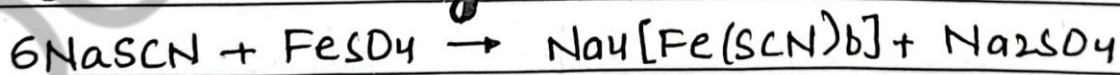
→ Nitrogen test

- Take a portion of Lassaigne's sol or filtrate. (NaCN).
- Add few drops of NaOH to make it alkaline.
- Add freshly prepared FeSO_4 solution in it.
- Boil the sol.
- Add few drops of FeCl_3 & HCl into it.
- blue or greenish blue (Prussian blue) → proves presence of nitrogen.
- if blood red color is produced it proves presence of sulphur & nitrogen.

Equation of nitrogen



Equation of nitrogen & sulfur



→ Detection of Sulphur 1

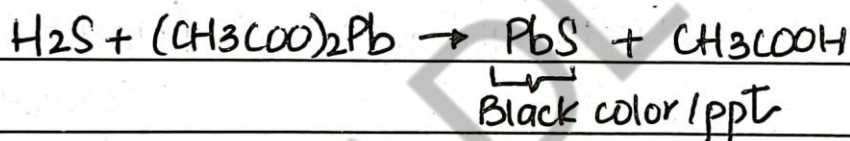
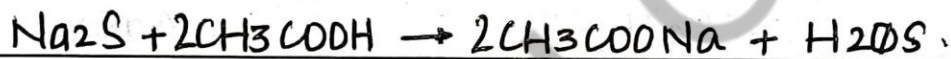
Procedure:

- Take second portion of Lassaigne's solution.
- This sol is acidified by adding acetic acid.
- Boil this sol.
- We need to expel out H_2S gas. This gas is a very rotten bad smell.
- For last verification, we take either lead acetate sol or lead acetate paper.
- By dipping paper or adding sol we get results.

Results:

Black spots on paper & pure black color in H_2S sol.

Equation:



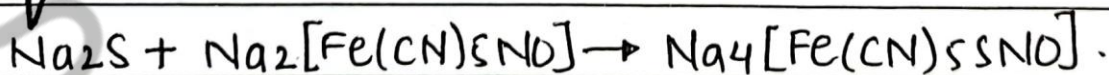
The main reagent in Sulphur detection is Lead sulfate.

→ Detection of Sulphur 2 MDCAT imp:

Procedure:

- Taking Lassaigne's solution containing sulphur.
- Add Sodium nitro prusside.
- If violet color appears, it shows presence of sulfur.

Equations:



↳ violet ppt



→ Detection of halogen

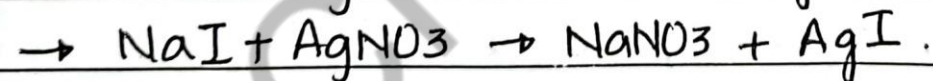
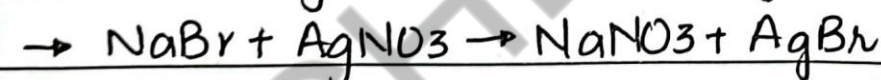
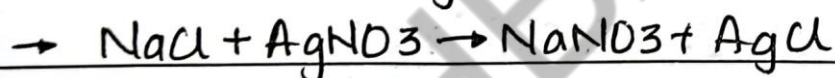
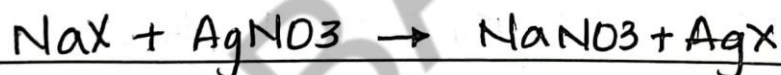
Procedure :

- Take third portion of Lassaigne's sol.
- It's boiled with conc. HNO_3 to expel the cyanide (CN^-) & sulphide ions (S^{2-}).
- Cool this sol.
- Add AgNO_3 in it.
- The formation of some ppt with specific ^{colors} results which the results.
- Adding NH_4OH with each halogens like Cl & Br & I .

Results:

- | | | |
|--|--------------------------------------|---|
| • Deep yellow (I) | • White ppt (Cl) | • Pale yellow |
| • AgI | • AgCl | • AgBr |
| • NH_4OH insoluble ppt | • NH_4OH soluble ppt | • NH_4OH partial soluble. |

Equation:



alkaloid

Any class of nitrogenous O.C of plant origin which have pronounced physiological action on human.

e.g:- quinine, morphine, nicotine.

So due

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Q#1: What is water gas?

- Water gas is a type of synthetic natural gas (SNG) that is produced from water.
- It is produced by a process called Gasification, where H_2O is converted into CO_2 , H_2 , CH_4 by reaction under $800^\circ C$.
- The resulting gas is colorless, odorless, tasteless and non-toxic.
- Used for industrial process, vehicles etc.

Q#2: What is coal gas, how it is obtained?

- Coal gas also known as town gas is widely used as fuel.
- It is produced by heating coal in absence of air at high temp.
- It can be obtained by :-
 - 1- Coal selection :- $\uparrow$ carbon & $\downarrow$ S.
 - 2- Washing and cleaning: rid of impurities.
 - 3- Gasification: heated at $800^\circ C - 900^\circ C$ producing numerous products.
 - 4- Purification: rid of S, NO etc.



Q#3. difference between Partial & Total synthesis?

Partial Synthesis**Total Synthesis****Definition**

- In this synthesis, an intermediate product of reaction is used to synthesis required product.

- In this synthesis, the starting material is converted through many steps into targeted product.

Source

- Compounds are isolated from natural sources.

- Compounds are synthesized from cheap & available source.

Steps

- limited steps must be followed.

- Proper max steps must be followed.

intermediate

- intermediate is formed.

- intermediate is not formed.

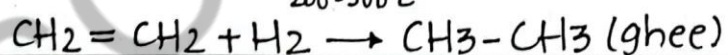
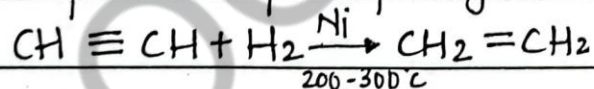
favourable

- less favourable as it's not economical.

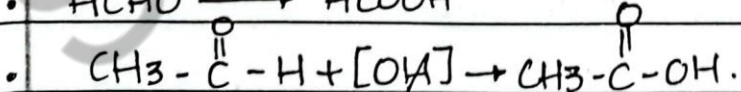
- more favourable becoz it's economical.

examples

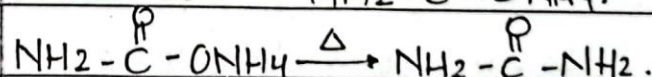
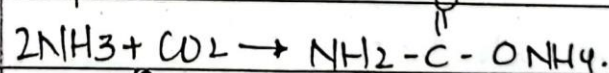
- Preparation of soap or ghee.



- $\text{HCHO} \xrightarrow{\text{oxid}} \text{HCOOH}$



- Preparation of Urea.



- $\text{CH}_4 \xrightarrow{\text{oxid}} \text{CH}_3 - \text{OH} \xrightarrow{\text{oxid}} \text{HCHO} \xrightarrow{\text{oxid}} \text{HCOOH}$

Q#4: Difference b/w destructive & fractional distillation.

destructive distilla	Fractional distillati
----------------------	-----------------------

— definition —

- | | |
|--|---|
| <ul style="list-style-type: none"> A process that involve decomposition of a solid by heating it in a closed container. | <ul style="list-style-type: none"> A process that separate hydrocarbon components on different boiling points. |
|--|---|

— Separation —

- | | |
|--|--|
| <ul style="list-style-type: none"> Separation of components via decomposition of solid. | <ul style="list-style-type: none"> separation of components to difference in boiling point. |
|--|--|

— Material —

- | | |
|---|--|
| <ul style="list-style-type: none"> for coal. | <ul style="list-style-type: none"> for coal gas, crude oil. |
|---|--|

— Uses —

- | | |
|--|---|
| <ul style="list-style-type: none"> No involment of gases. | <ul style="list-style-type: none"> involment of gas. |
|--|---|

Q#5 Products ~~Products~~ produced by hydrolysis of coal.

Liquid Product:

- Coal tar • Coal oil • heavy oil

Solid Product:

- Coke • CHAR

Chemical:

- Phenol • benzol • benzene • toluene • Xylene etc.

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