HYDROCARBON

#→ The important source of Energy.
Example :
LPG, CNG, Petrol, Kerosene etc.

Classification
There are three classification of Hydrocarbon

→ Saturated → Alkane

→ Unsaturated → Alkene, Alkyne

→ Aromatic → Benzene, Toutene, Toluene

→ # Introduction

1) first member of Alkane are CH_4 (1-carbon)
2) First members of Alkene (C_2H_4) (2-carbon)
3) First member of Alkyne C_2H_2 (2-carbon).
4) first member of Aromatic are Benzene C_6H_6 (6-c
5

In any series there is increament of CH_2 and Atomic number 14, Atomic Mass - 14 amu

Alkane

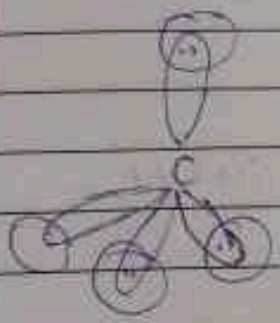
→ General formula C_nH_{2n+2}

→ 1st Member CH_4 → Methane
→ Marsh gas
→ found in marshy area

→ 2nd member are adding with CH_2 and give C_2H_6

→ They are also called paraffins (chemically inert) paraffin means very less reactive with base and acid.

→ Structure CH_4 → sp^3 → 109.5°
→ tetrahedral



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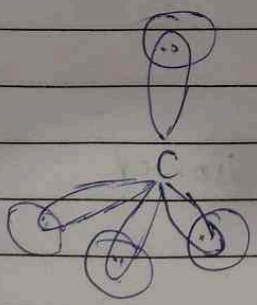

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(6-c)

→ IUPAC

① $CH_3-\underset{\uparrow}{CH}-CH_3$ (↑ CH_3)

2-methyl Propane

② $CH_3-CH_2-\underset{|}{CH}-\underset{|}{CH}-CH_3$ (CH_3, CH_3)

2,3 - Dimethyl Pentane

③ $CH_3-\underset{|}{\overset{CH_3}{\overset{|}{C}}}-CH_3$ (CH_3)

2,2 Dimethy Propane.

→ Isomers

The shows only chain, position, Confirmation isomer.

eg.

① C-C-C-C-C-C — chain isomer

② C-C-C-C-C (C, C) — position

③ C C C C C (C) — chain

④ C-C-C(C)-C (C) — position

⑤ C(C)-C-C(C)-C (C)

NOTE

→ C_7H_{14+2} = C_7H_{16} → 9 isomers

$C_{10}H_{22}$ → 75 isomers.

Method of preperation

(a) from Unsaturated hydrocarbon (Hydrogenation)

(a) from Alkene

Reduction / Addition of H_2

$$CH_3-CH=CH-CH_3 + H_2 \xrightarrow[\text{Pt, Pd OR Raney Ni}]{\text{in Presence}} CH_3-CH_2-CH_2-CH_3$$

But 2- ene — Butane

Note (1) Raney Ni is the mix of Aluminium and Ni in ratio 3:1, it is powdered form

(2) Raney Ni is the best catalyst amongst other two because it is cheaper catalyst

(b) from Alkynes

$$CH_3-C\equiv C-CH_3 + 2H_2 \xrightarrow{\text{Raney Ni}} CH_3-CH_2-CH_2-CH_3$$

But 2-yne — Butane

→ Reduction

→ Addition Rxn

Note ; Term R – X
↓ Alkyl, ↳ Halogen

★ (2) From Alkyl halide.

(a)

eg :- (1) $CH_3 - Cl + H_2 \xrightarrow{Zn/H^+} CH_4 + HCl$

Chloromethane, H-(1-1), Methane

→ This is a substitution Reaction.

eg (2) $CH_3 - CH_2 - CH_2 - Cl + H_2 \xrightarrow{Zn/H^+} CH_3 - CH_2 - CH_3$

(3) $CH_3 - \underset{\underset{CH_3}{|}}{CH} - CH_2 - Br + H_2 \xrightarrow{Zn} CH_3 - \underset{\underset{CH_3}{|}}{CH} - CH_3 + HBr$

(b) Wurtz Reaction

→ This reaction only made symmetrical even alkane

eg :- Butane, ethane, hexane, etc.

↓ why.

1) R–X (of 1 carbon) → R–R (2 carbon)
R–X (of 2 carbon) → R–R (4 carbon)

$CH_3-Cl \longrightarrow CH_3-CH_3$

$CH_3-CH_2-Cl \longrightarrow CH_3-CH_2-CH_2-CH_3$

Short trick to remember this reaction → It make mirror of Alkyl as it product.

→ $2CH_3-Cl + 2Na \xrightarrow[\text{dry ether}]{} CH_3-CH_3 + 2NaCl$

→ $CH_3-CH_2-Cl + CH_3-CH_2-Cl + 2Na \xrightarrow[\text{dry ether}]{} CH_3-CH_2-CH_2-CH_3$

→ $CH_3-\underset{CH_3}{CH}-Cl + CH_3-\underset{CH_3}{CH}-Cl + 2Na \longrightarrow CH_3-\underset{CH_3}{CH}-\underset{CH_3}{CH}-CH_3$

→ Why it does not make Reaction with two diff Alkyl

$CH_3-Cl + CH_3-CH_2-Cl + 2Na \longrightarrow CH_3-CH_3 + CH_3-CH_2-CH_3 + CH_3-CH_2-CH_2-CH_3$

Q Can I form Methane from wurtz reaction
(a) No (b) Yes

Methane can not be prepared by this method

(3) From Decarboxylation of sodium salt of acid.

$$CH_3-COO^-Na^+ + NaOH \xrightarrow[\Delta]{CaO} CH_4 + Na_2CO_3$$

Best method for making CH_4

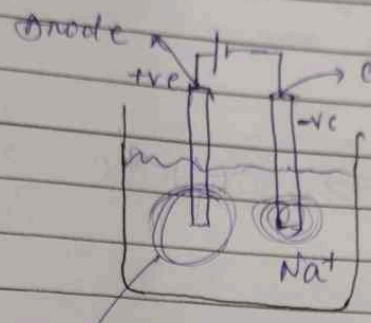
→ Sodium salt of ethanoic acid when heated with soda lime [CaO + NaOH] give alkanes 1-C less than the reactant

$$CH_3-CH_2-CH_2-COONa \xrightarrow[CaO,\ \Delta]{NaOH} CH_3-CH_2-CH_3 + Na_2CO_3$$

Sodium salt of butanoic acid is heated to form propane.

(4) Kolbe's Electrolysis.

↳ happens in aqueous



$CH_3 - CH_2 - COO^-$

~~At~~

~~At Anode~~

$$2\,CH_3-CH_2-\overset{\overset{O}{\|}}{C}-O^- \xrightarrow[\text{Remove}]{2e^-} 2\,CH_3-CH_2^{\bullet} + 2\,CO_2\uparrow$$

$$2\,CH_3-CH_2^{\bullet} \longrightarrow CH_3-CH_2-CH_2-CH_3$$

~~At~~ cathode.

$$H_2O + 2e^- \longrightarrow OH + H^{\bullet}$$

$$H^{\bullet} + H^{\bullet} \longrightarrow H_2$$

Kolbe's Electrolysis gives carbon increased.

2C compound $\xrightarrow{4\times2}$ (4C) − (2C) ⟶ Product

$CH_3 - CH_3$

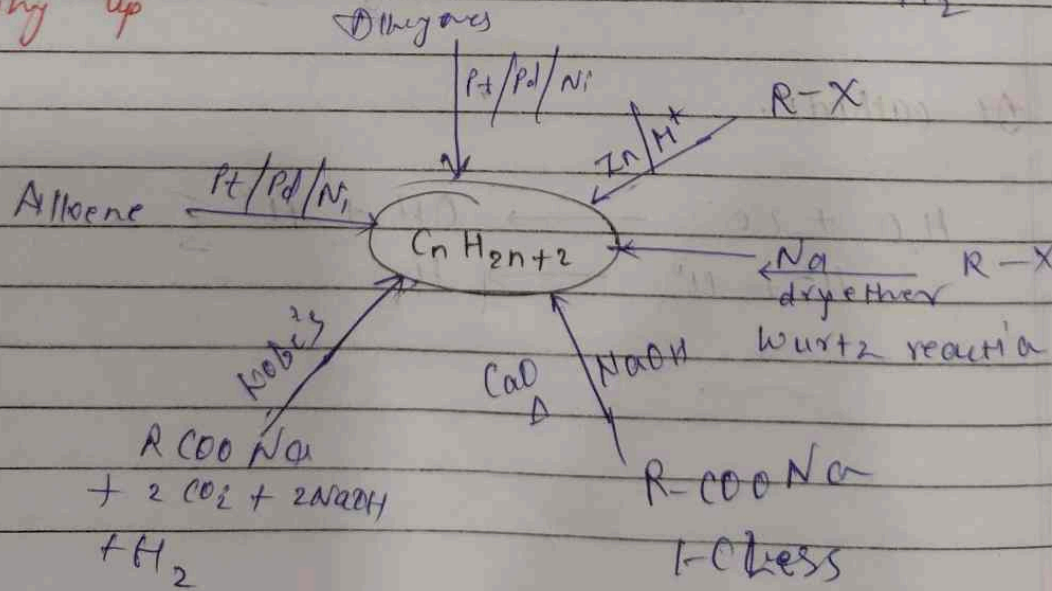
3C Acid ⟶ 3C + 3C → 6C − 2C → 4C (Product)

→ Kolbe's Electrolysis in sodium salt of butanoic acid.

$CH_3 - CH_2 - CH_2 - COONa \xrightarrow{electrolyte} CH_3-(CH_2)_4-CH_3 + 2CO_2 + 2NaOH + H_2$

$CH_3COOH \xrightarrow{electrolyte} CH_3 - CH_3 + 2CO_2 + 2NaOH + H_2$

Summary up



Q1 ~~Conversion~~

Conversion

Q1 Ethyl chloride to butane. ~~& ethane~~ butane

$$2\,CH_3-CH_2-Cl \xrightarrow[\text{dry ether}]{2\,Na} CH_3-CH_2-CH_2-CH_3$$

Q2 ~~Propanoic~~ acid to butane.

~~$CH_3-COOH \longrightarrow CH_3-CH_2-CH_2-CH_3$~~

$$CH_3-CH_2-COONa \xrightarrow[H_2O]{\text{electrolyte}} CH_3-CH_2-CH_2-CH_3 + 2CO_2 + 2NaOH + H_2$$

Physical properties

Solubility :- Alkanes are always almost non-polar in nature so they are insoluble in water but soluble in Organic solvent.

State. C_1 to C_4 are gas C_5 to C_{17} → liquid
C_{18} and above wax like solid.

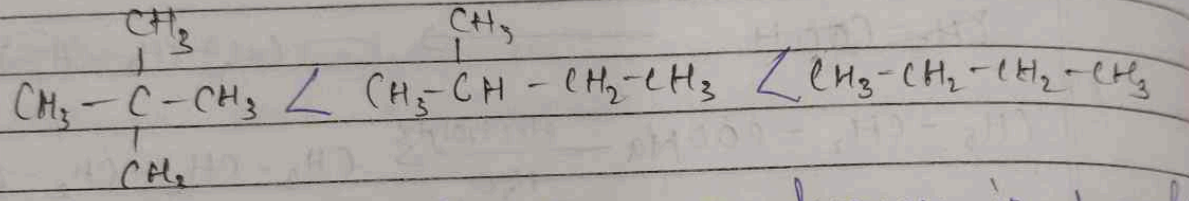
Color and odour They are colorless and odourless petrol and a mixture of hydro carbon used as fuel in automobile. and they are also use in dry cleaners industries.

Boiling points - Boiling point are very less due to found weak vander waal bond.

Density Their Density are less than water that's why they float in water

Taste They are taste less

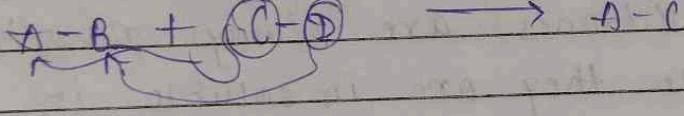
When increase in branching Boiling point decreases



Boiling pt increasing becoz of decrease in branch

Chemical Properties.

① Substitution Reaction

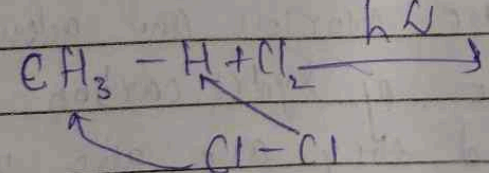


a) Halogenation

Happens in high temp about 573 to 773 K

OR in

hν → Sunlight



$CH_4 + Cl + Cl \xrightarrow{h\nu} CH_2Cl_2$

$CH_2Cl_2 + Cl_2 \xrightarrow{h\nu} CHCl_3$

$CHCl_3 + Cl_2 \xrightarrow{h\nu} CCl_4$

→ Reactivity Order

for Halogen

$F_2 > Cl_2 > Br_2 > I_2$

for Alkane

$3^\circ > 2^\circ > 1^\circ$

Mechanism.

(a) Initiation

$Cl_2 \xrightarrow{h\nu} Cl \cdots Cl \rightarrow 2Cl^\circ$

(b) Propogation / Elongation

(1) $CH_4 + 2Cl^\circ \xrightarrow{h\nu} CH_3^\cdot + H^\circ + 2Cl^\circ$

$CH_3^\circ + 2Cl^\circ \xrightarrow{h\nu} CH_2Cl^\circ + Cl^\cdot + H^\cdot$

$CH_2Cl^\circ + 2Cl^\circ \xrightarrow{h\nu} CHCl_2^\cdot + Cl^\circ + H^\circ$

$CHCl_2^\circ + 2Cl^\circ \xrightarrow{h\nu} CCl_3^\circ + Cl^\circ + H^\circ$

(c) Termination

$CH_3^\cdot + Cl^\cdot \longrightarrow CH_3Cl$

$CH_3^\cdot + H^\cdot \longrightarrow CH_4$

$H^\circ + Cl^\circ \longrightarrow HCl$

$H^\circ + H^\cdot \longrightarrow H_2$

$Cl^\circ + Cl^\cdot \longrightarrow Cl_2$

$CH_2Cl^\cdot + Cl^\circ \longrightarrow CH_2Cl_2$

$CH_3^{\cdot} + CH_2Cl^{\cdot} \longrightarrow CH_3-CH_2-Cl$

$H^{\cdot} + Cl^{\cdot} \longrightarrow HCl$

$Cl^{\cdot} + Cl^{\cdot} \longrightarrow Cl_2$

$H^{\cdot} + H^{\cdot} \longrightarrow H_2$

$CHCl_2^{\cdot} + Cl^{\cdot} \longrightarrow CHCl_3$

$CHCl_2^{\cdot} + CHCl_2^{\cdot} \longrightarrow CHCl_2-CH_2Cl_2$

But at last, we can also write as

$$CH_4 + Cl_2 \xrightarrow{h\nu} CH_3Cl,\ CH_2Cl_2,\ CHCl_3,\ CCl_4,\ H_2,\ Cl_2,\ HCl,\ CH_3-CH_3 \text{ etc.}$$

This Reaction followed by 3 steps

1. Initiation
2. Propagation
3. Termination.

(2) Combustion.

↳ Burning

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$$

$$C_2H_6 + \frac{7}{2}O_2 \longrightarrow 2CO_2 + 3H_2O$$

$$C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$$

$$C_nH_{2n+2} + O_2\left(\frac{3n+1}{2}\right) \longrightarrow nCO_2 + (n+1)H_2O$$

(3) T

(4)

Reagent used in Oxidation

③ Incomplete Combustion.

$CH_4 + O_2 \longrightarrow C + 2H_2O$

↳ In this CO_2 doesn't form because of incomplete Burning.

④ Controlled Oxidation.

Hydrocarbon $\xrightarrow{1\text{ time oxidat}^n}$ Alcohol $\xrightarrow{2\text{ times oxidation}}$ Aldehyde

Hydrocarbon $\xrightarrow{1\text{ time oxidation}}$ Acid

Hydrocarbon ↑ 1 time | Alcohol ↑ 1 time red | Aldehyde ↑ 1 time reduc | Acid

Reagent used in Oxidation:

1 time Oxidation $\longrightarrow Cu \mid 573\,K \mid 300\,atm$

2 times Oxidation $\longrightarrow Mn_2O_3 \mid CrO_3$

3 times Oxidation $\longrightarrow (CH_3COO)_2Mn$ Or $KMnO_4 \mid H_2SO_4$

Examples

1) $CH_4 + O_2 \xrightarrow[573\,K]{Cu} CH_3-OH$ (Alcohol)

2) $CH_3-CH_3 + O_2 \xrightarrow[\Delta]{Mn_2O_3} CH_3-CHO$ (Aldehyde)

3) $CH_3-CH_3 + O_2 \xrightarrow[\Delta]{(CH_3COO)_2Mn} CH_3COOH$ (Acid)

Explaination

(a) $CH_3-CH_2-H \xrightarrow[1\,time]{O_2} CH_3-CH_2-OH$

Carbon has one oxygen

(b) $CH_3-CH_2-OH \xrightarrow[1\,time]{O_2} CH_3-\overset{O}{\overset{\|}{C}}-H$

in this also 'C' as 2 O_2 but feels 2 O_2 like CH_4

$CH_3-\overset{O}{\overset{\|}{C}}-H \xrightarrow[1\,time]{O_2} CH_3-\overset{O}{\overset{\|}{C}}-OH$

Further carbon feels like it has 3-oxygen because it makes total 3-bonds with oxygen.

Important Reaction

$$CH_3-\underset{\underset{CH_3}{|}}{\overset{CH_3}{\overset{|}{C}}}-H \xrightarrow[H^+]{KMnO_4} CH_3-\underset{\underset{CH_3}{|}}{\overset{CH_3}{\overset{|}{C}}}-OH$$ (Alcohol)

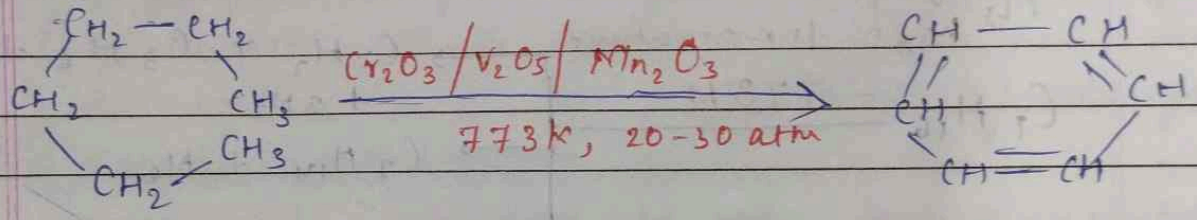
Reason behind formation of Alcohol is that the carbon having only one hydrogen and only one bond to recieve Oxygen.

(3) # ISOMERISATION

$CH_3-CH_2-CH_2-CH_2-CH_2-CH_3$ (n-Hexane) $\xrightarrow[HCl]{\text{Anhydrid } AlCl_3}$ $CH_2\ CH_2CH_2CH\ CH_3$ (2 methyl pentan) CH_3; $CH_3CH_2CH\ CH_2CH_3$ (CH_3) (3 methyl pentane) etc....

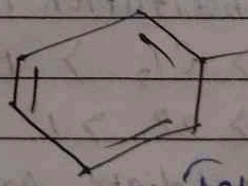
n-Alkane on heating in the presence of anhydrous Aluminium chloride and HCl gas isomerise to branched chain alkanes.

(4) # AROMATISATION

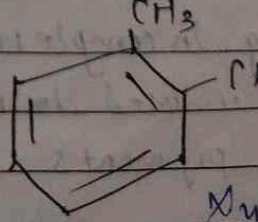


C_6H_{14} Hexane → C_6H_6 Benzene

n-Alkanes having six or more carbon atoms on heating to 773 K at 10-20 atm pressure in the presence of oxides of Vanadium molybdenum or Chromium supported over alumina get dehydrogenated.

$C_7H_{16} \xrightarrow[10-30\ atm]{Cr_2O_3,\ 773K}$ 

Toluene

$C_8H_{18} \xrightarrow[20-30\ atm]{Mn_2O_3,\ 773K}$ 

Xylene.

(5) Reaction with Steam

$$CH_4 + H_2O \xrightarrow{773K,\ Ni} \underbrace{CO + 3H_2}_{\text{Industrial gas}}$$

(6) Pyrolysis

↳ with temperature

$$C_7H_{16} \xrightarrow{-773K} \begin{cases} \rightarrow C_2H_2 + C_3H_4 + C_2H_4 + 2H_2 \\ \rightarrow C_7H_{14} + H_2 \\ \rightarrow C_3H_6 + C_4H_8 + H_2 \end{cases}$$

Some Important points.

1) In substitution reaction the reactivity order are

$F_2 > Cl_2 > Br_2 > I_2$

$3^\circ > 2^\circ > 1^\circ$

Intermediate are Carbon free radical

2) During incomplete combustion Carbon black is formed which is used in manufacturing of ink, printer ink, black pigments as filter

3) 3° Alkyl oxidise with $KMnO_4$ and form 3° Alcohol

4) Aromatization reaction are also called reforming reaction.

5) Pyrolysis reaction are also called cracking

6) Pyrolysis follows free radical reaction i.e, they form various no. of product.
This method used for preperation of oil, gas petrol gas, kerosene oil

This reaction undergoes at very high temperature. In the ability of.

$$C_{12}H_{26} \xrightarrow[973K]{Pt/Pd/Ni} C_7H_{16} + C_5H_{10} + \text{other product}$$

7) In commercial gasolines the types of hydrocarbon which is more desirable is straight chain hydrocarbons

Isomerism in Alkane.

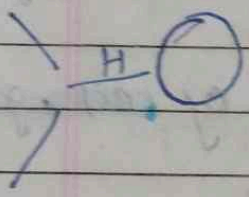
Conformation

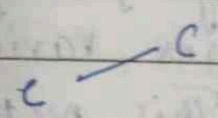
Conformation in Ethane C_2H_6

SP^3 → rotation

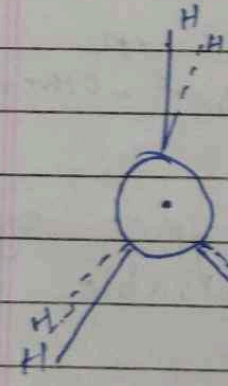
① Newman Configration

② Saw horse Conf



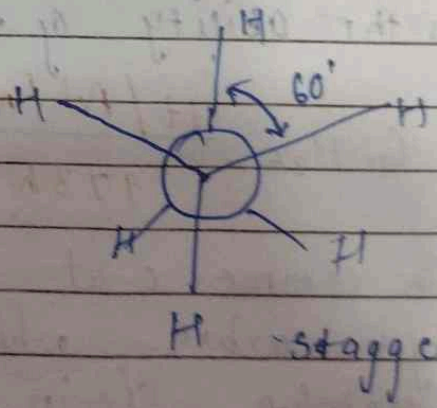


① Newman



(for ethane)

Eclipssed



Staggered

★ Stability

Staggered > Eclipsed

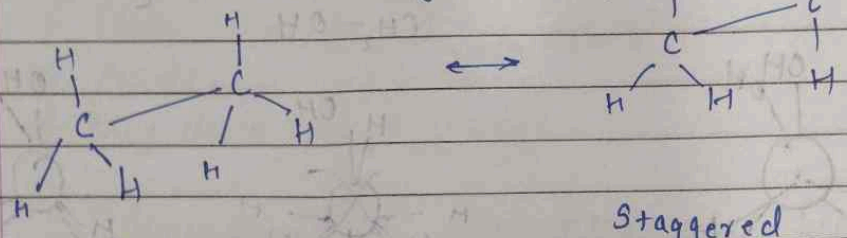
Eclipsed

0°, 120, 240°, 360° → other than these angle → skew 72°, 84°,

Staggered

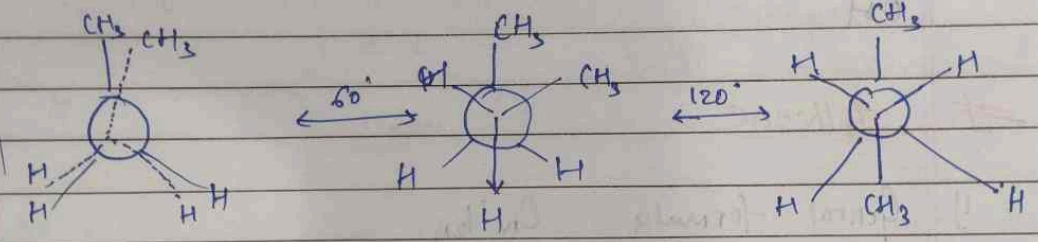
60°, 180°, 300

② Saw horse (for ethane)



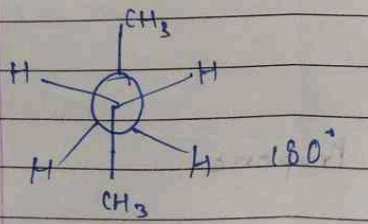
Eclipsed ⟷ Staggered

→ # for Butane

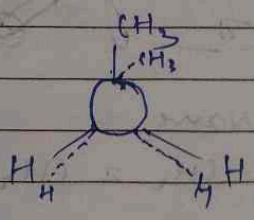


Eclipsed — gauche — anti (staggered) etc....

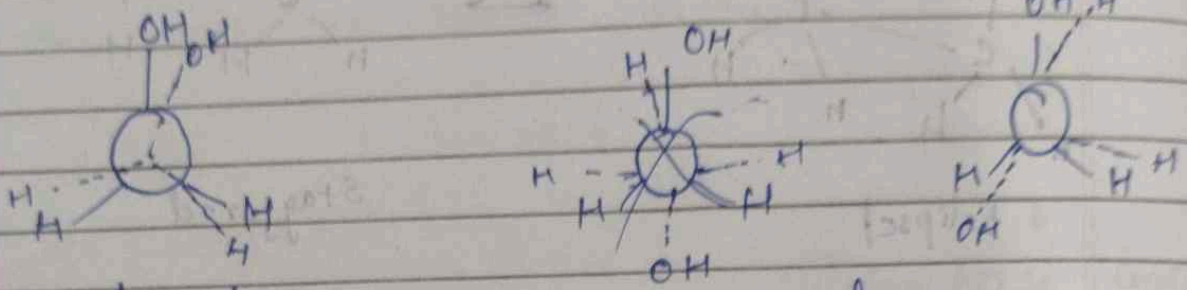
→ Stable: anti (staggered)



less stable: Eclipsed



Q which is more stable [JEE]



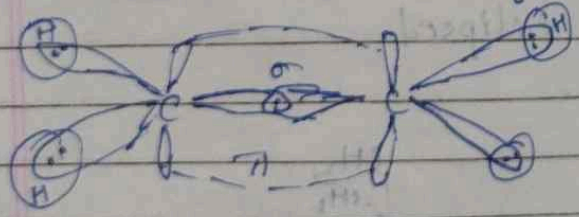
Eclipsed

Staggered

→ Eclipsed is more stable because of H-bond b/w OH

Alkene

1) General formula C_nH_{2n}
2) 1st Member → C_2H_4 ethene.
3) Olifins
4) SP_2 hybridization
5) Structure → Trigonal



6) IUPAC Name

1) $CH_3-CH_2=CH_2$ Propene

2) $CH_3-\underset{\underset{CH_3}{|}}{CH}-CH=CH_2$ 3-Methyl But ene

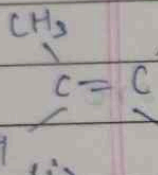
3) $CH_2=CH-CH=CH_2$ But 1,3 di-ene

7) Isomers shown by alkenes
1) chain
2) Position
3) Ring chain
} structure

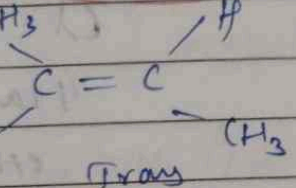
1) Geometrical

Condition for Geometrical isomers
① same carbon have two diff groups
② Double Bond

Cis



Trans



Cis

Trans

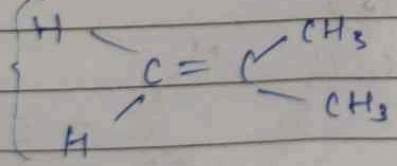
⇒ stability ↑, Cis < trans (dipole moment)

dipole moment → Cis > trans
stability trans > Cis

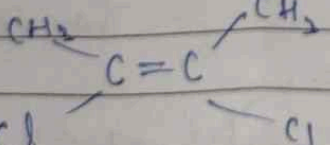
Cis > trans (Boiling point)

which shows Geometric isomers

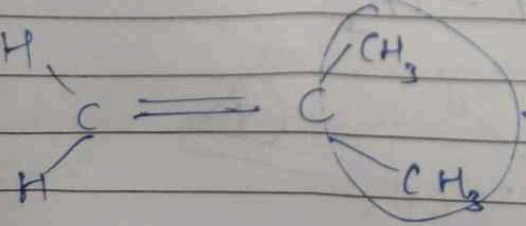
Same



→ No isomers



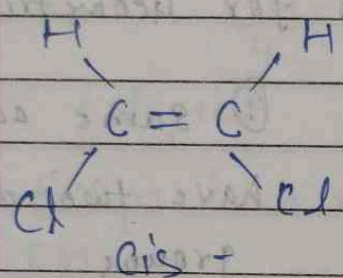
→ Cis (Geometrical)



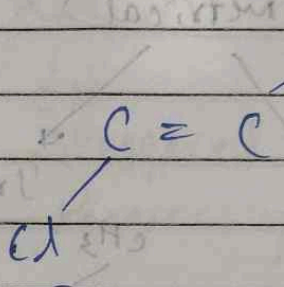
→ Same groups No isomer

→ Boiling point
cis > trans.

Q// Make $CHCl = CHCl$, cis/Trans and write IUPAC Name.

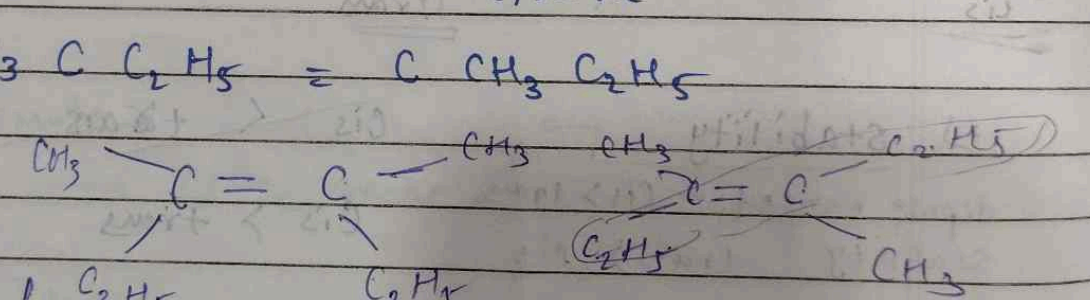


cis -



Trans 1,2 dichloro ethene

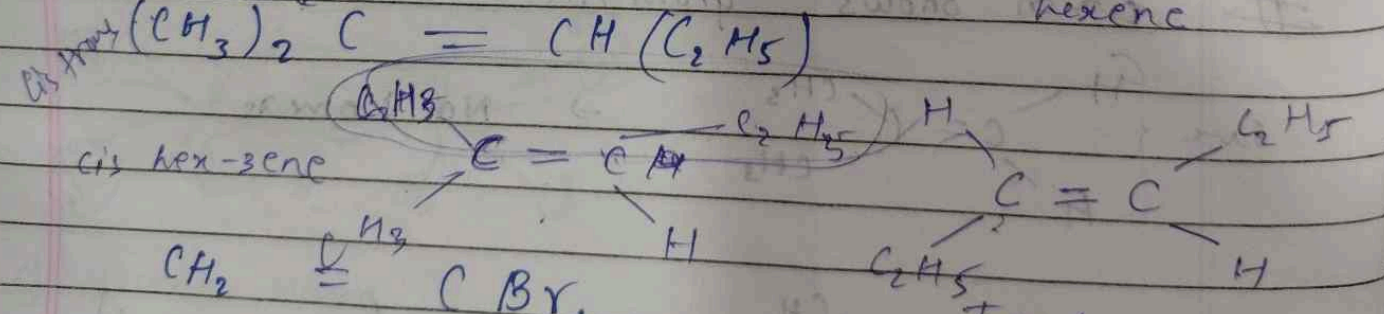
Home work



cis - 2,3 Dimethyl 3-hexene

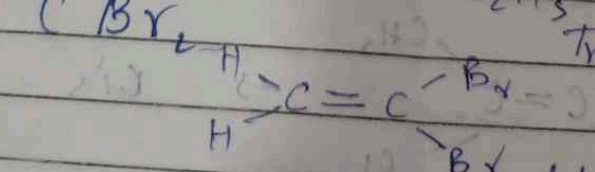
2,3 - dimethyl hex-3-ene

Tran 2,3 Dimethyl 3-hexene

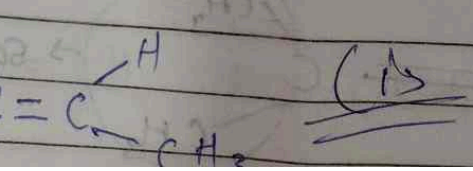


cis hex-3-ene

Tran hex 3-ene



1,1 Dibromo ethane

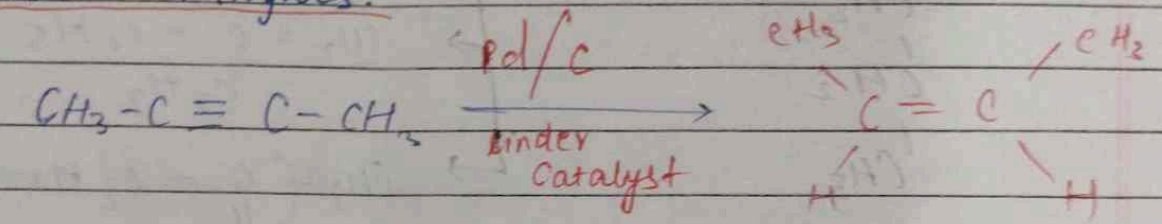


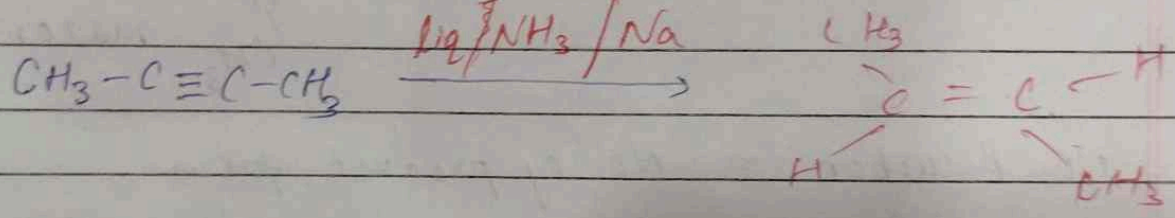
$CH_3CH \equiv CCl CH_3$

~~# Metho~~

Method of preperation.

1) From Alkynes.



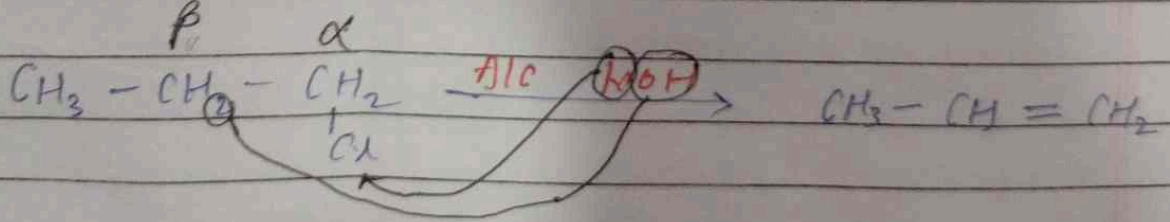


2) From Alkyl halides

Removal of (HX)

↳ Dehydro halogenation

↳ α, β elimination reaction



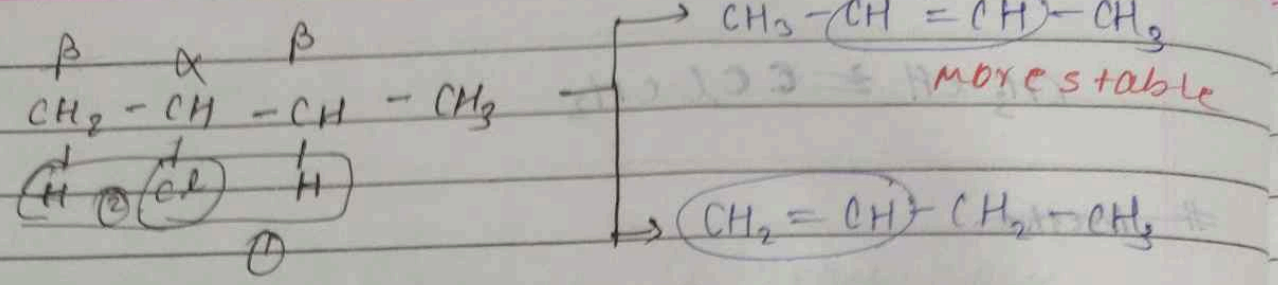
→ For more than 1 β carbon → use Saitzeff Rule

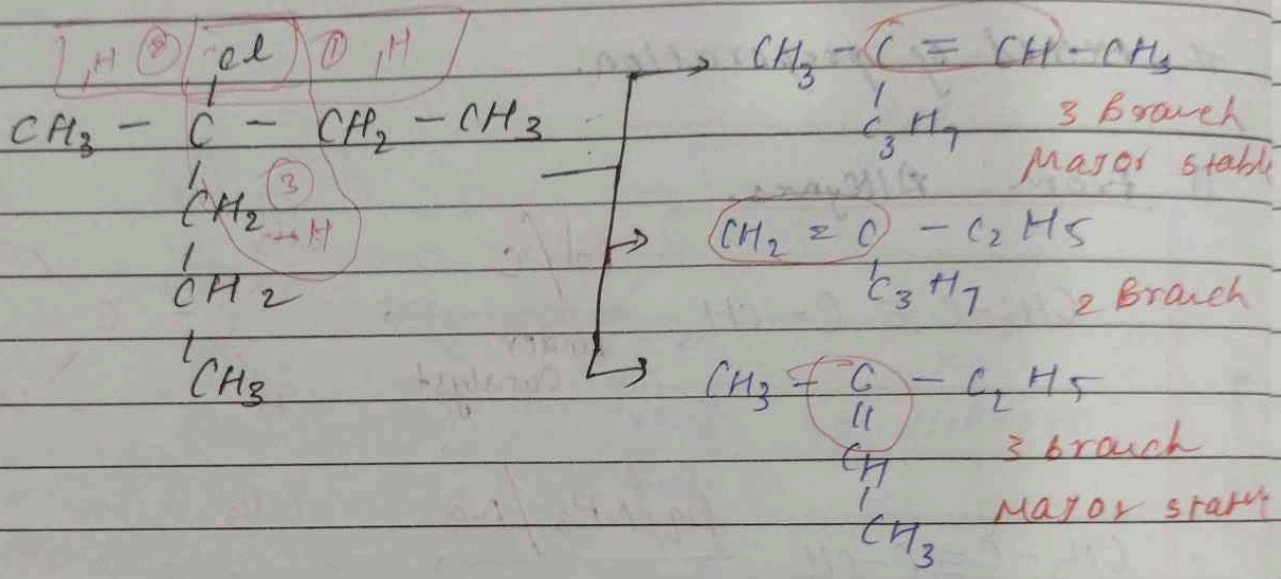
↓

multiple product form

And from these multiple products double bond carbon branch is most stable.

Eg





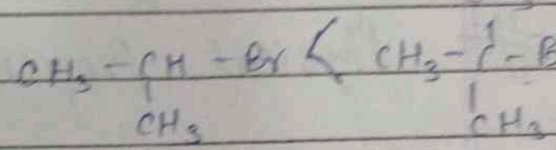
No. β carbon = No. of product form

Alkyl halide Reactivity

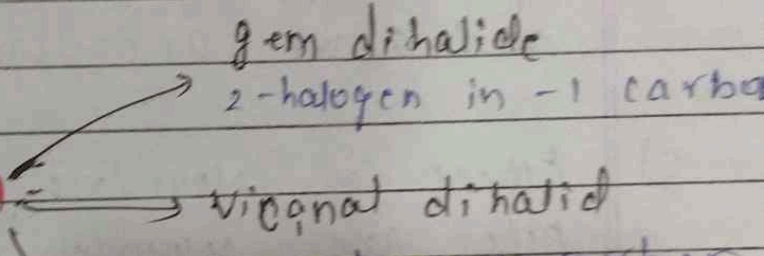
R-X :- R-I , R-Br , R-Cl > R-F

R (Alkyl group)

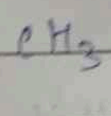
3° > 2° > 1°



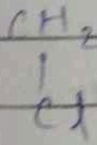
From Vicinyl di-halide

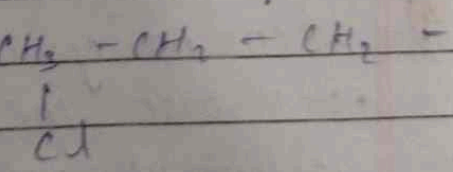


gem

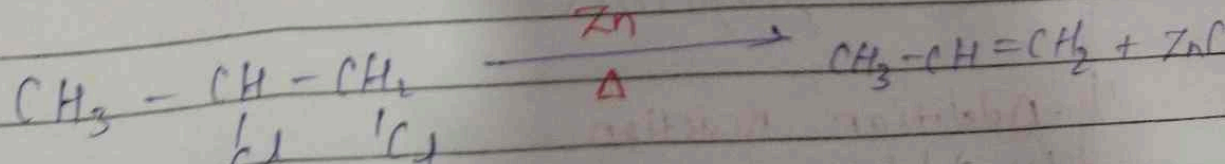


Vicinal





3) from Vicinal Di-halide



4) α, β elimination De hydration

$$CH_3-\underset{OH}{\overset{\alpha}{CH}}-\underset{H}{\overset{\beta}{CH_2}} \xrightarrow{\text{Conc. } H_2SO_4} CH_3CH=CH_2 + H_2O$$

Physical Properties.

1) $C_1 \xrightarrow{\text{to}} C_3$ are gas
$C_4 \longrightarrow C_{14}$ are liquid ...
and above are wax like solid.

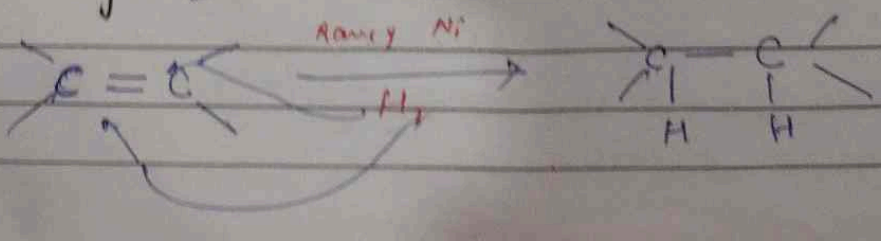
2) Ethene is colourless gas with sweet smell but other are colourless and odourless.

3) They are insoluble in water but fairly soluble in polar solvent

4) when no. of carbon increases boiling point and melting point also increases each carbon increases, boiling pt increase by 20K to 30K

Chemical properties

1) Addition Reaction
(a) Addition of H_2



eg (a)

$CH_2 = CH_2 + H_2 \xrightarrow[\Delta]{Ni/Pt/Pd} CH_3 - CH_3$

Ethene → Ethane

(b) Addition of halogen

$CH_2 = CH_2 + Br_2 \xrightarrow{CCl_4} \underset{\substack{| \\ Br}}{CH_2} - \underset{\substack{| \\ Br}}{CH_2}$

Vicinal dihalide

(c) Addition of HX (Hydro halogenation)

→ (i) for Symmetrical Alkene

$CH_2 = CH_2 + H-Br \longrightarrow CH_3 - CH_2 - Br$

$\longrightarrow \underset{\substack{| \\ Br}}{CH_2} - CH_3$

→ (ii) for Unsymmetrical Alkene.

$CH_3 - CH = CH_2 + H-Br$

① $CH_3 - \underset{\substack{| \\ Br}}{CH} - CH_3$ (Major)

② $CH_3 - CH_2 - CH_2 - Br$

→ To identify which product is major use

Markovnikov → it tells more H
↳ add → H

, and less H
↳ Add Br

C = C

mark addition

↳ eg

$CH_3-C(CH_3)=CH_2 + HBr$

(1) Hydrogen (2) Hydrogen

→ (1) $CH_3-C(CH_3)(Br)-CH_3$

→ (2) $CH_3-CH(CH_3)-CH_2-Br$

Mechanism

→ Intermediate → Carbocation

Step - I

$CH_3-CH=CH_2 + HBr$

↓

$CH_3-\overset{+}{C}H-CH_3$ 2°
more stable

$CH_3-CH_2-\overset{+}{C}H_2$ 1°
less stable

Step - II Br → Attack

$CH_3 - \overset{+}{C}H - CH_3$ More stable

$CH_3 - \underset{Br}{CH} - CH_3$

$CH_3 - CH_2 - CH_2^+$ less stable

$CH_3 - CH_2 - CH_2 - Br$

↳ Anti Markovnikov Addition

Peroxide effect

↳ Kharash effect

→ Intermediate ⇒ Carbon free radical

H - add on less H

Br - add on more H

$CH_3 - CH = CH_2 \xrightarrow[\text{Peroxide}]{(C_6H_5-CO)_2} CH_3 - CH_2 - CH_2 - Br$ MAJOR

H_2O_2

$(C_6H_5COO)_2$

$CH_3 - \underset{Br}{CH} - CH_2$

↳ This reaction only happens in unsymmetrical alkenes

↳ In this reaction only HBr is used but not HCl and HI

Q. Identify the major product

1) $CH_3-CH_2-\underset{\oplus}{CH}=\underset{\oplus H}{CH_2} + HBr$

Markovnikoff

→ $CH_3-CH_2-\underset{Br}{CH}-CH_3$ Major

~~Markovnikoff addition~~

→ $CH_3CH_2CH_2\underset{Br}{CH_2}$

2) $CH_3CH_2\underset{1H}{CH}=\underset{2H}{CH_2} + HBr$

Peroxide → $CH_3CH_2\underset{Br}{CH}CH_3$ Major

Anti Markovnikoff: Peroxide → $CH_3CH_2CH_2\underset{Br}{CH_2}$ Major

(4) Addition of H_2SO_4 (Sulphuric Acid)

↓

Mark. addition

$CH_3CH=CH_2 + H_2SO_4 \longrightarrow CH_3-\underset{HSO_4}{CH}-CH_3$

$CH_2=CH_2 + H_2SO_4 \longrightarrow CH_3CH_2-\left(O-\overset{O}{\overset{\|}{S}}(=O)-H\right)$

(5) Addition of water (H-OH)

$CH_3-CH=CH_2 + H-OH \rightleftharpoons CH_3-\underset{OH}{CH}-CH_3$

2° Alcohol

$CH_2=CH_2 + H-OH \longrightarrow CH_3-CH_2-OH$

1° Alcohol

⑥ Oxidation (In Neutral)

$CH_2=CH_2 + KMnO_4 + H_2O \longrightarrow CH_2(OH)-CH_2(OH)$

($KMnO_4 \rightarrow [O]$; OH OH)

ethylene Glycol

$CH_3-CH=CH_2 + KMnO_4 + H_2O \rightarrow CH_3-CH(OH)-CH_3(OH)$

Propane-1,2 di-ol

(In Acidic)

$CH_3-C(CH)=CH_2 + KMnO_4 \longrightarrow CH_3-C(CH_3)=O + H_2O + CO_2$

$KMnO_4 \rightarrow [O]$

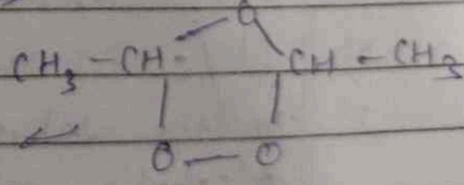
($H_2O + CO_2$: By product)

$CH_3-CH=CH-CHO \xrightarrow{KMnO_4/H^+} CH_3-COOH + CH_3-COOH$

OO OO

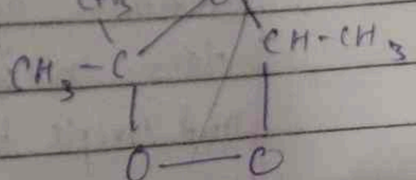
⑦ Ozonolysis

$CH_3-CH=CH-CH_3 + O_3 \xrightarrow[H_2O]{Zn}$



$\leftarrow CH_3CHO + CH_3CHO$

$CH_3-C(CH_3)=CH_3-CH_3 + O_3 \xrightarrow[H_2O]{Zn}$



$CH_3-C(=O)-CH_3 + CH_3CHO$

⑥ Oxidation (In Neutral)

$$CH_2=CH_2 + KMnO_4 + H_2O \longrightarrow \underset{OH}{CH_2}-\underset{OH}{CH_2}$$

$KMnO_4$ → [O]; OH — OH added across the double bond

ethylene Glycol

$$CH_3-CH=CH_2 + KMnO_4 + H_2O \rightarrow CH_3-\underset{OH}{CH}-\underset{OH}{CH_3}$$

Propane-1,2 di-ol

(In Acidic)

$$CH_3-\underset{CH}{C}=CH_2 + KMnO_4 \longrightarrow CH_3-\underset{CH_3}{C}=O + H_2O + CO_2$$

$KMnO_4$ → [O]

$H_2O + CO_2$: By product

$$\underset{OO}{CH_3-CH}=\underset{OO}{CH-CHO} \xrightarrow{KMnO_4/H^+} CH_3-COOH + CH_3-COOH$$

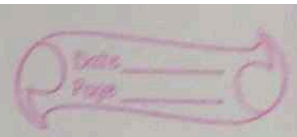
⑦ Ozonolysis

$$CH_3-CH=CH-CH_3 + O_3 \xrightarrow[H_2O]{Zn} CH_3-CH\overset{O}{\frown}CH-CH_3 \text{ (with } O-O \text{ bridge)}$$

$$\leftarrow CH_3CHO + CH_3CHO$$

$$CH_3-\overset{CH_3}{C}=CH_2-CH_3 + O_3 \xrightarrow[H_2O]{Zn} CH_3-\overset{CH_3}{C}\overset{O}{\frown}CH-CH_3 \text{ (with } O-O \text{ bridge)}$$

$$\swarrow \quad CH_3-\overset{O}{\overset{\|}{C}}-CH_3 + CH_3CHO$$



$$CH_3-\underset{\underset{CH_3}{|}}{C}=CH-CH_2-CH_3 + O_3 \xrightarrow[H_2O]{Zn} CH_3-\overset{O}{\overset{\|}{C}}-CH_3$$

$$CH_3-CH_2-CHO$$

(8) Polymerisation

$$n\left(CH_2=CH_2\right) \xrightarrow[\text{high Pressure}]{\text{high temp}} -\left(CH_2-CH_2\right)_n-$$

n-Ethene — catalyst — Poly ethene ↓ Polythene

$$n\left(CH_2=\underset{\underset{CH_3}{|}}{CH}\right) \xrightarrow{\text{high press / Ten}} -\left(CH_2-\underset{\underset{CH_3}{|}}{CH}\right)_n-$$

Propene — Poly Propene

Some important Points

1) Polarity and melting point are higher in Cis than trans and Stability of trans is higher than Cis.
2) Pd/C are also called 'lindlar's catalyst
3) In the dehydration of alcohol KOH are called Alcoholic KOH
4) Addition of Br_2 in Alkene are called unsaturation test in which orange colour disappear when D.B and Triple bond are present.

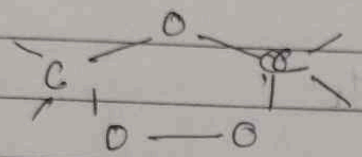
$$CH_2=CH_2 + Br_2 \xrightarrow{CCl_4} \underset{\underset{Br}{|}}{CH_2}-\underset{\underset{Br}{|}}{CH_2}$$

[Orange colour]

5) In markovnikoff addition intermediate are carbocation

6) In anti mark addition intermediate are carbon free radical.

7) During Ozonolysis the intermediate which have 3 oxygen are called Ozonide.



Ozonide

8) Polyethene is used in making of (a) plastic bags (b) Squeeze bottle (c) refrigerator dishes. (d) Toys (e) Pipes (f) radio and TV cabinate etc.

Polypropene is used for making of plastic bucket with carets, and other moulded article

Alkynes

1) General formula → C_nH_{2n-2}
2) 1st member → C_2H_2 (Ethyne, Acetylene)

C_2H_2 is plant Harmone which is gas, and is use to ripppen fruits and is highly flamable gas. also used in gas welding

$$CaC_2 + 2H_2O \longrightarrow Ca(OH)_2 + C_2H_2$$

3) IUPAC Naming

(a) $CH_3 - C \equiv C - \underset{|}{\overset{}{C}}H - CH_3$ with CH_3 on the branch

(b) $CH_3 - C(CH_3)(CH_3) - C \equiv CH$

(c) $CH_3\ CH_2 - C \equiv C - CH = CH_2$

4) Hybridization → sp
Shape → linear, angle = 180°

Preparations of alkynes

1) from Calcium Carbide

$$CaCO_3 \xrightarrow{\Delta} CaO$$

$$CaO + 3C \xrightarrow{\Delta} CaC_2 + CO$$

$$CaC_2 + 2H_2O \xrightarrow{\Delta} Ca(OH)_2 + C_2H_2$$

↳ If after rxn CO is form then Temp is 1500°

2) from Vicinal dihalide (halides in adj carbons)

$$CH_3 - \underset{Br}{CH} - \underset{Br}{CH_2} \xrightarrow[-KBr\ -H_2O]{Alc\ KOH} CH_3 - \underset{Br}{C} = CH_2$$

$$CH_3 - \underset{Br}{C} = CH_2 \xrightarrow[-NaBr\ -NH_3]{NaNH_2} CH_3 - C \equiv CH$$

Physical properties of Alkyne

(1) First three members are gas, the next eight are liquid and higher are solid

(2) All are colourless and have a specific odour only in ethyne

(3) Alkynes are weakly polar in nature. They are less soluble in water but soluble in non polar solvent like ether, CCl_4 and Benzene

(4) Density and Boiling increases when increasing in molar mass.

Chemical property.

1) Acidic effect of no. of hydrogen present.

→ $CH \equiv CH$ > $CH \equiv C - CH_3$ > $CH_3 - C \equiv C - CH_3$
2 acidic H, 1 Acidic H, 0 Acidic H

→ $CH_3 - CH_3$ < $CH_2 = CH_2$ < $CH \equiv CH$
SP_3, SP_2, SP

Hyb of EN

$$R - C \equiv C \cdots H$$
(C: −δ, H: +δ)

$$R - C \equiv C^- + H^+$$

Acid + Metal → H_2 gas ↑

Acid + Base → salt + water

Acid + hydro carbonate → salt + H_2O + CO_2

→ $2(R-C\equiv C-H) + 2Na \longrightarrow 2R-C\equiv C^-Na^+ + H_2$

→ $R-C\equiv C-H + NaOH \longrightarrow R-C\equiv C^-Na^+ + H_2O$

→ $R-C\equiv C-H + NaHCO_3 \longrightarrow R-C\equiv C^-Na^+ + H_2O + CO_2$

$CH_3-C\equiv C^-Na^+$ (sodium propanide)

(2) Addition of H_2

$CH\equiv CH \xrightarrow[+H_2]{Pt/Pd/Ni} CH_2=CH_2 \xrightarrow{Pt/Pd/Ni} CH_3-CH_3$

(b) Addition of Halogen

$CH_3-C\equiv CH + Br_2 \longrightarrow CH_3-C(Br)=CH(Br)$

$\longrightarrow CH_3-C(Br)_2-CH(Br)_2$

1,1,2,2 Tetra bromo Propane

(c)

(3) Poly

→ (i)

$2n($

$[n($H

(c) Addition of Hydro halogen (Mark addition)

$CH_3 - C \equiv CH + H-Br \longrightarrow CH_3 - \underset{Br}{C} = CH_2$

Mark ↓

$CH_3 - \underset{Br}{\overset{Br}{C}} - CH_3$

gem → geb carbon ki Br

gem di halid

(d) Addition of water (Mark addition)

$CH_3 - C \equiv CH + H-OH \xrightarrow{Mark} CH_3 - \underset{OH}{C} = CH_2$

$H-OH$ ↓ Mark

$CH_3 - \underset{OH}{\overset{OH}{C}} - CH_3$

gem di-ol

there is no existence of [gem di-ol]

$CH_3 - \overset{O}{\overset{\|}{C}} - CH_3 \xleftarrow{-H_2O}$ (same gem di-ol)

(3) Poly merisation

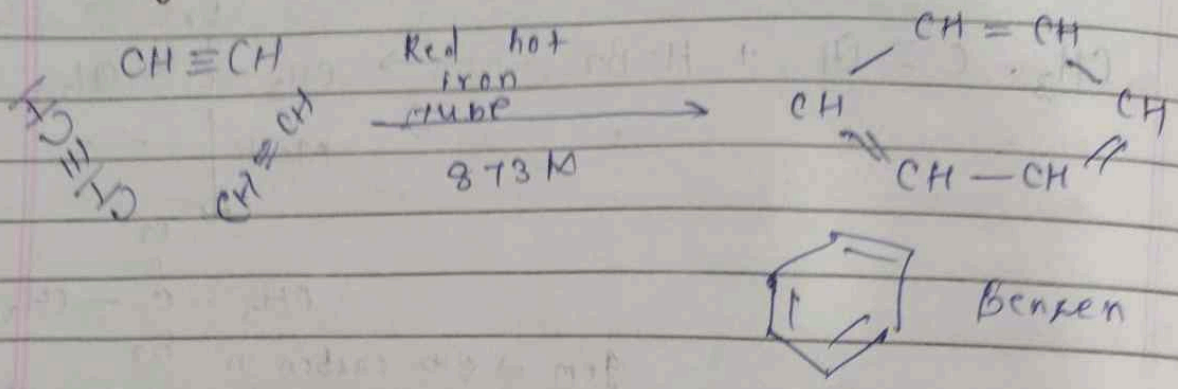
→ (1) linear Polymerisation

$n\{CH \equiv CH\} \longrightarrow \{CH = CH - CH = CH\}_n$

↓

$n\{HC$

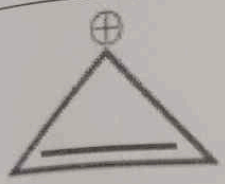
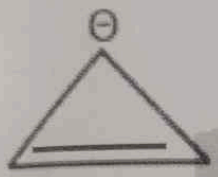
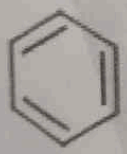
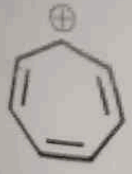
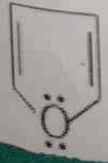
Cyclic polymerisation

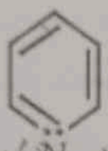
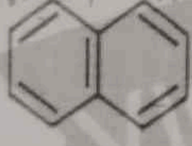
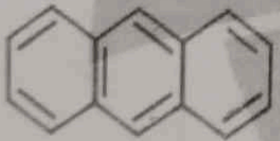
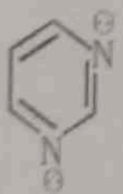
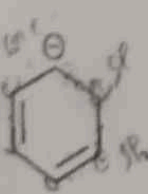
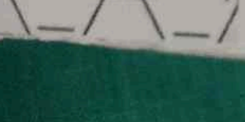


Benzen

ADDRESS – 1ST FLOOR PRADEEP PLAZA, IN FRONT OF CHOPRA PALACE , ADARSH NAGAR DURG
MO 9424168056,8269055301

AROMATIC /NON AROMATIC /ANTI AROMATIC

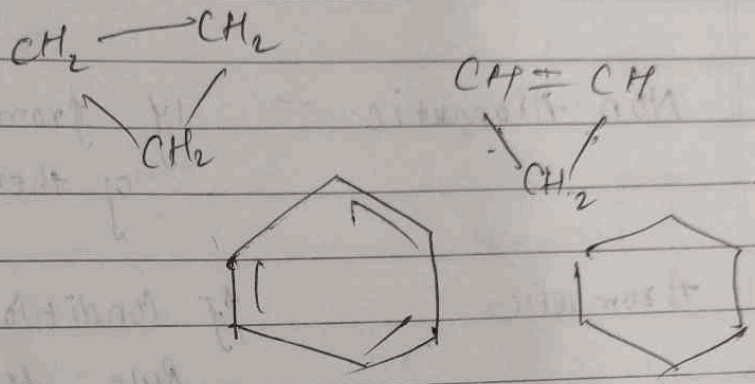
S.NO	COMPOUNDS	CYCLIC	PLANNER	RESONANCE	HUCKLES RULE	AROMATIC YES/NO
1.		✓	✓	✓	2π e⁻ ✓	Yes
2.		✓	✓	✓	4πe⁻ ✗	NO Anti Aro
3.		✓	✓	✓	4πe⁻	NO
4.		✓	✓	✓	6πe⁻ ✓	Yes
5.		✓	✓	✓	6πe⁻ ✓	Yes
6.		✓	✗	✓	4πe⁻ ✗	NON AROMATIC
7.		✓	~~✓~~	✓	6πe⁻ ✓	Yes
8.		✓	✓	✓	8πe⁻ ✓	Yes

9.		✓	✓	✓	6πe⁻	Yes
10.		✓	✓	✓	6πe⁻	Yes
11.	 in this N we don't include LP as we form the condition of aromaticity is N	✓	✓	✓	6πe⁻	~~NO~~ Yes
12.		✓	✓	✓	10πe⁻	Yes
13.		✓	✓	✓	14πe⁻	Yes
14.	 6πe⁻ sp2				6πe⁻	Yes
15.		✓	Y	Y	6πe⁻	~~Yes~~ NO
16.	exception 				12πe⁻	Non

AROMATIC

Some condition follows during identify of aromatic compounds

1) Cyclic



2) Planner (2D)

→ SP_2 hybridisation

→ SP hybridisation

3) Resonance

(1) = — =

(2) = — +ve

(3) = — +ve

(4) = — .. lone pair

4) Huckle's Rule follow → $(4n+2)\ \pi e^-$

If = .. = $2\pi e$

-ve / ⊖ = $2\pi e^-$

If no. of lone pairs are there we choose only in an atom ⇒ (..) $2\pi e^-$

Non Aromatic → If from conditions 1, 2, 3 any of them not followed

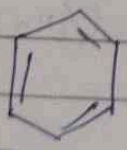
Aromatic → If condition 1, 2, 3 and Huckle's Rule follow

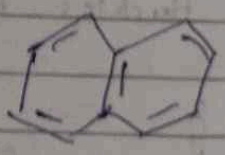
Anti - Aromatic → If condition 1, 2, 3 followed but Huckle's Rule not followed

4 Conditions are
- Cyclic
- Planner
- Resonance
- Huckle's Rule

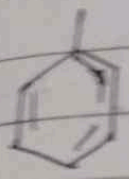
AROMATIC HYDROCARBON

Some types of Aromatic hydro carbon

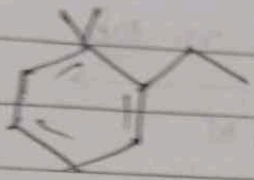
① Benzene 

② Naphthalene 

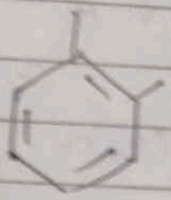
IUPAC Names



Methyl benzene

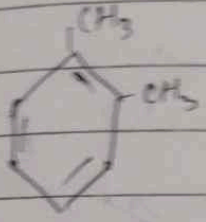


2-Ethyl-1,1 Dimethyl benzene

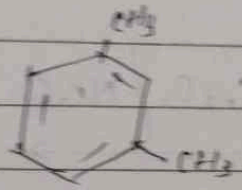


Xylene

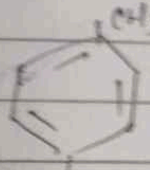
1,2-Di-methyl benzene



O- Xylene

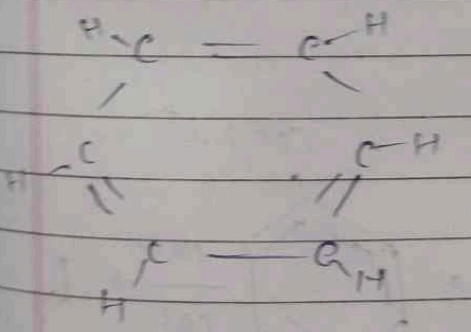


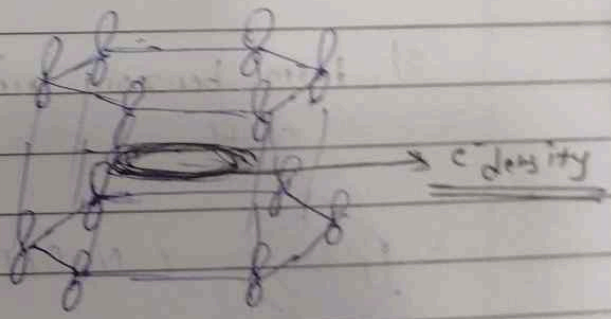
M- Xylene



P- Xylene

Structure of Benzene



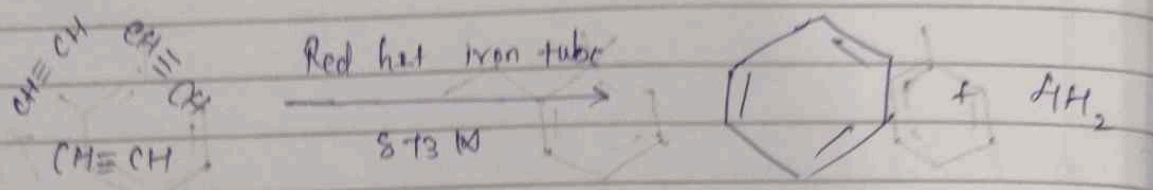


~~Paper~~

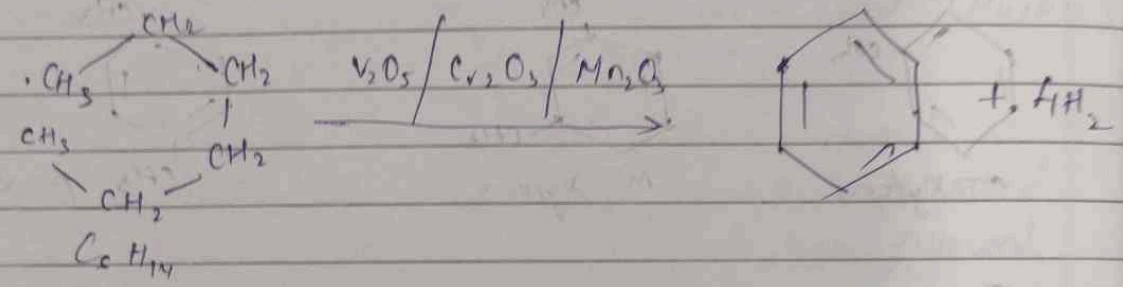
Important Note:- If two H atom replaced by two similar or different monovalent atom or groups so as isomer possible The 1,2 OR 1,6 known as Ortho (O-) The 1,3 and 1,5 known as meta and 1,4 know to be as para (p-)

Method of preparation of benzenes

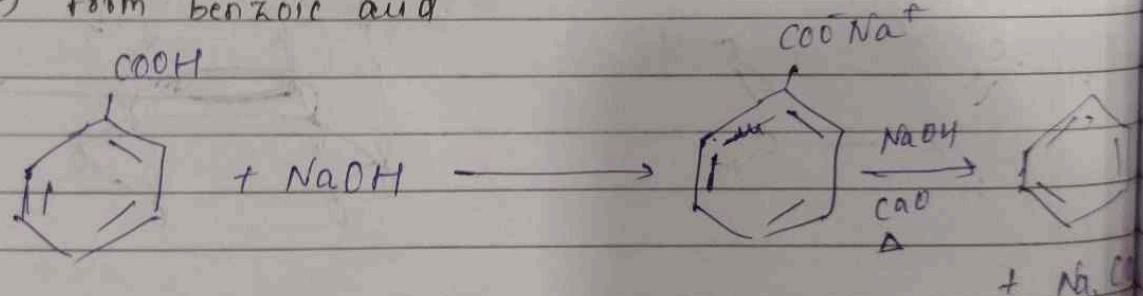
1) Cyclic Polymerisation



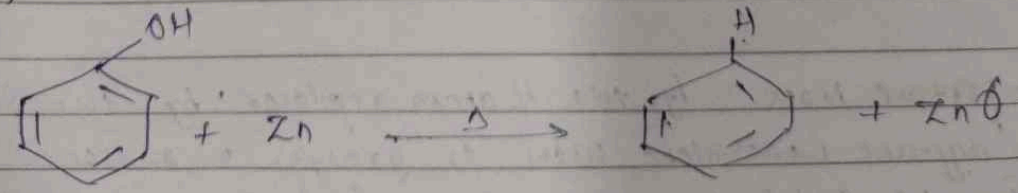
2) Aromatisation



3) from benzoic acid



4) from Phenol



Physical Properties of Hydrocarbon

1) Aromatic hydrocarbon are non-polar and they are usually colorless liquid

which have a specific aroma which is used in soaps and for preservation of cloth because of the unique smell of the compound and moth repelent property.

Aromatic hydrocarbon are immiscible with water but ~~can~~ readly miscible with Organic solvent

They are burn with soothy ~~smell~~ flame.

→ Colour → Colorless

→ Odour → Odourless

→ Taste → Bitter

→ Solubility → Non Polar

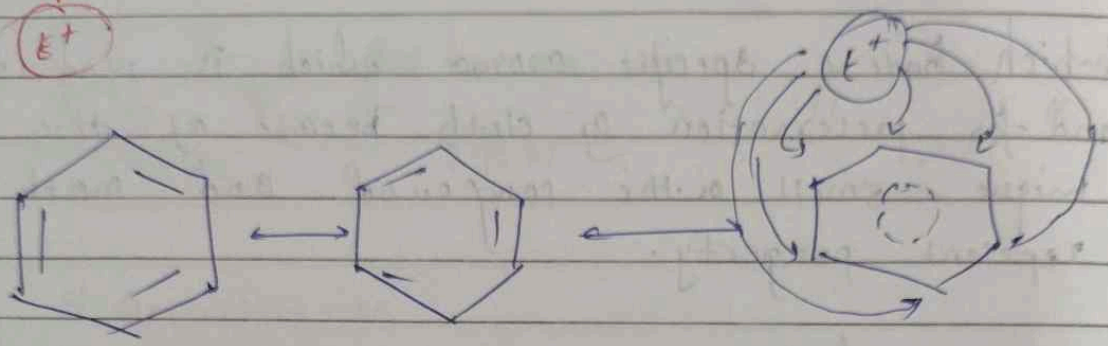
→ Phase → liquid

→

CHEMICAL PROPERTIES

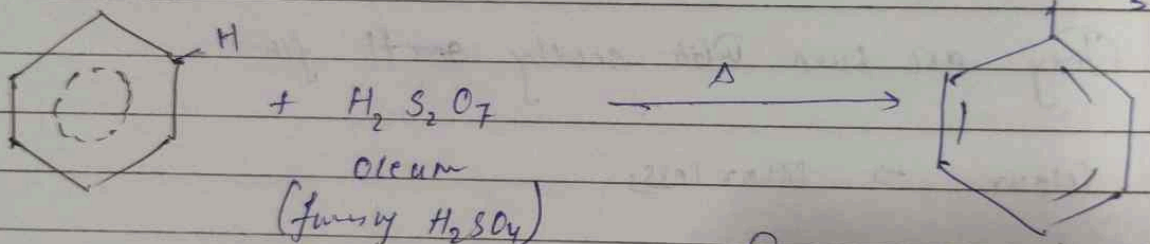
(1) Electrophilic Substitution Rxn

E^+



more Electron density

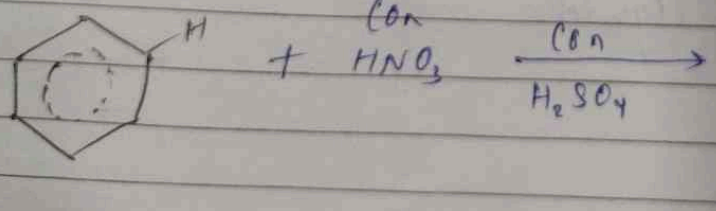
(a) Sulphonation



Benzene sulphonic acid

→ Attacking Reagen → HSO_3^+

(b) Nitration

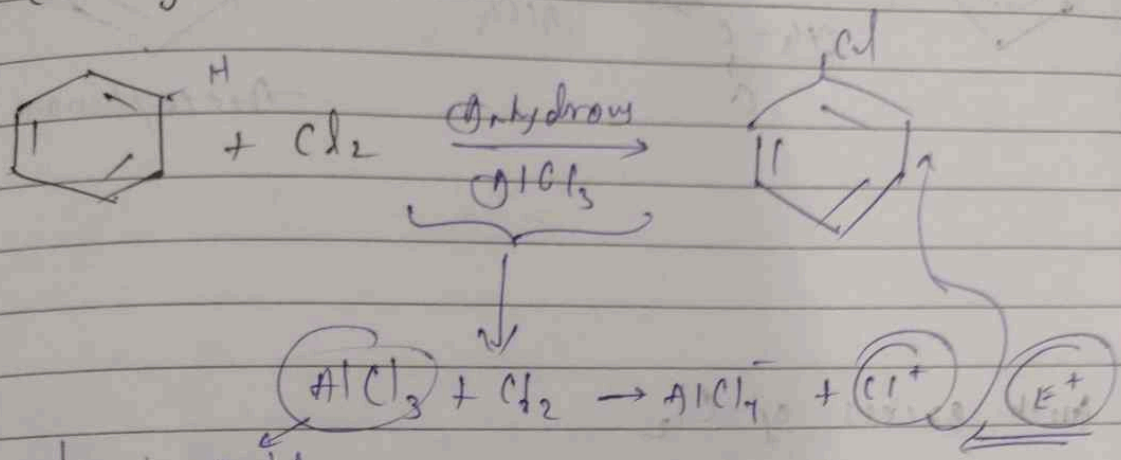


Nitro benzene

$E^+ \rightarrow NO_2^+$

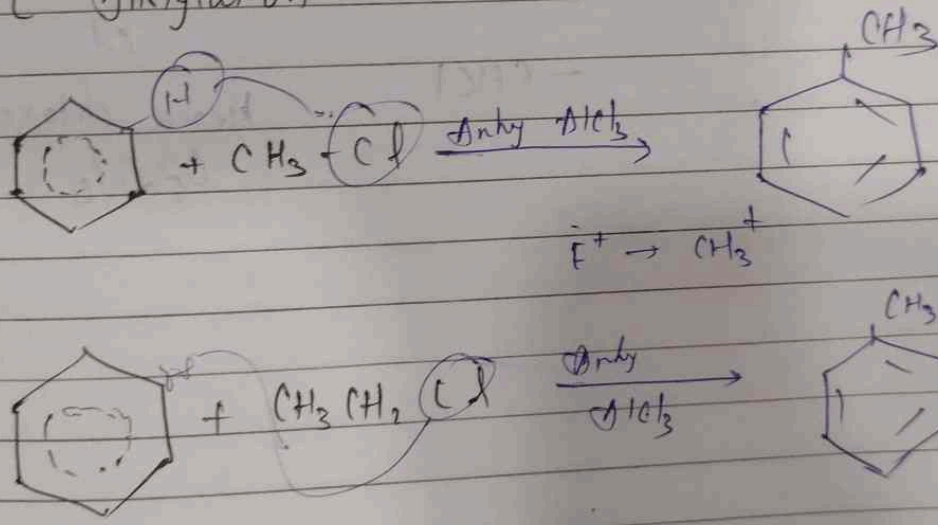
#(2) Friedel Craft

(a) F.C halogenation Rxn

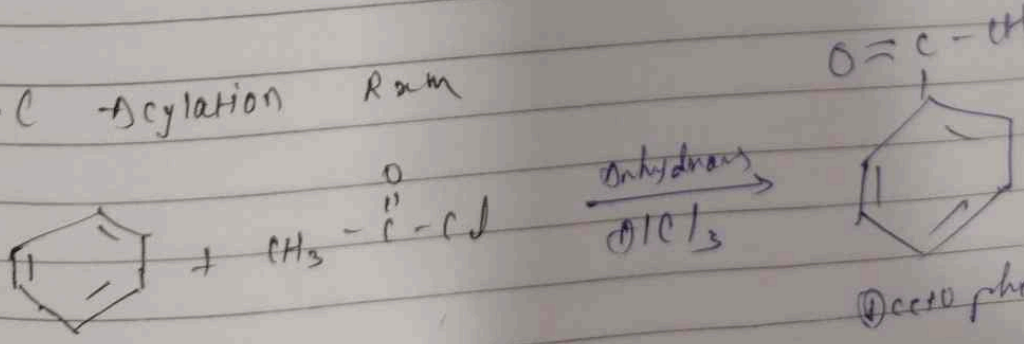


(b)

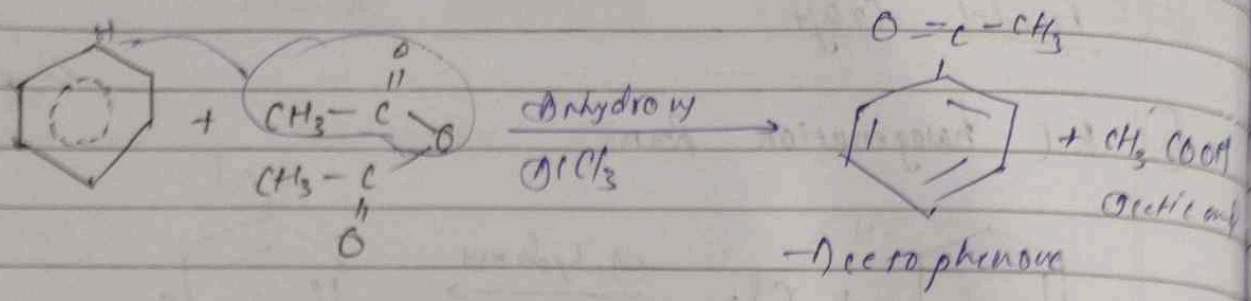
(3) F.C Alkylation Rxn



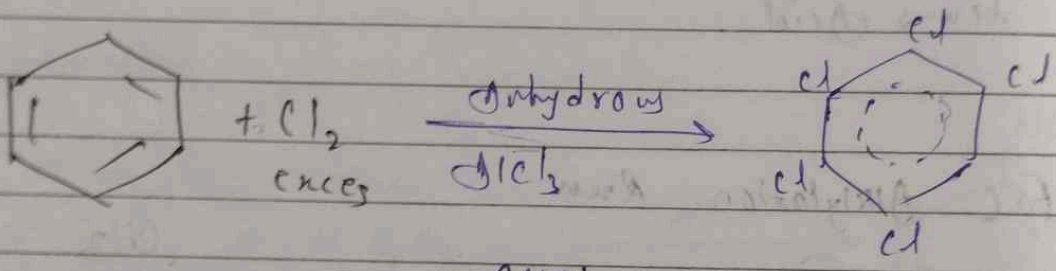
(c) F.C Acylation Rxn



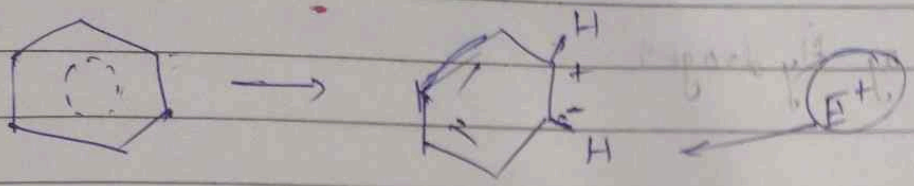
(4) Acetophenone



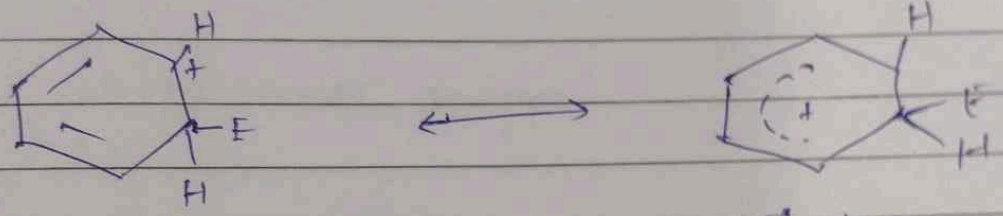
(d) With excess of Cl_2



Formation of Arenium ion intermediate

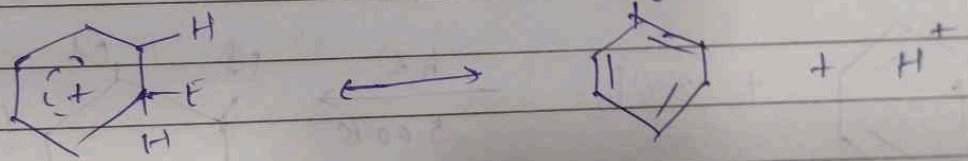


$AlCl_3 + Cl_2 \rightarrow [AlCl_4]^-$



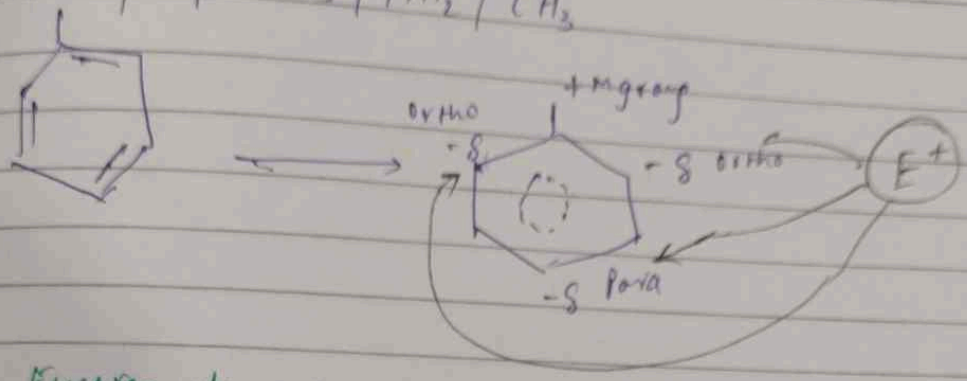
Arenium intermediate

Arenium



ORTHO / PARA Directing groups

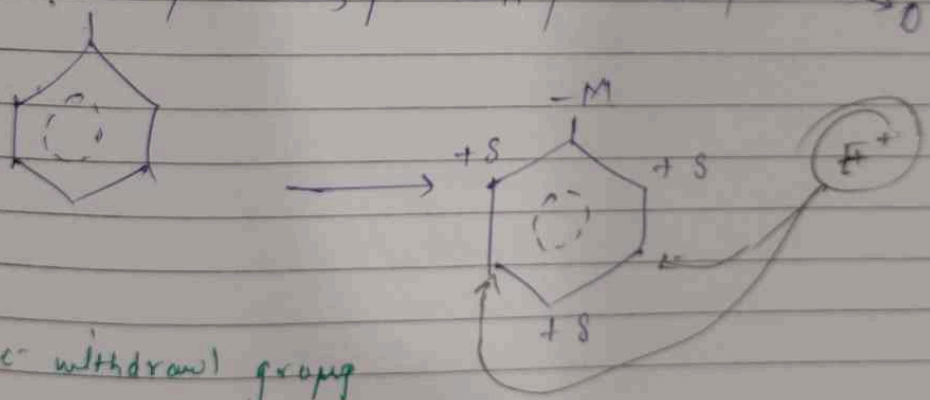
$\ddot{O}H$ / $\ddot{C}l$ / $\ddot{O}CH_3$ / $\ddot{N}H_2$ / CH_3



→ Electron donor groups

Meta directing groups

$C\equiv N$ / $-\overset{\overset{O}{\|}}{C}-CH_3$ / $-\overset{\overset{O}{\|}}{C}-H$ / $-\overset{\overset{O}{\|}}{C}-\ddot{O}H$ / $-N\begin{matrix}=O\\ \rightarrow O\end{matrix}$



→ e⁻ withdrawl group