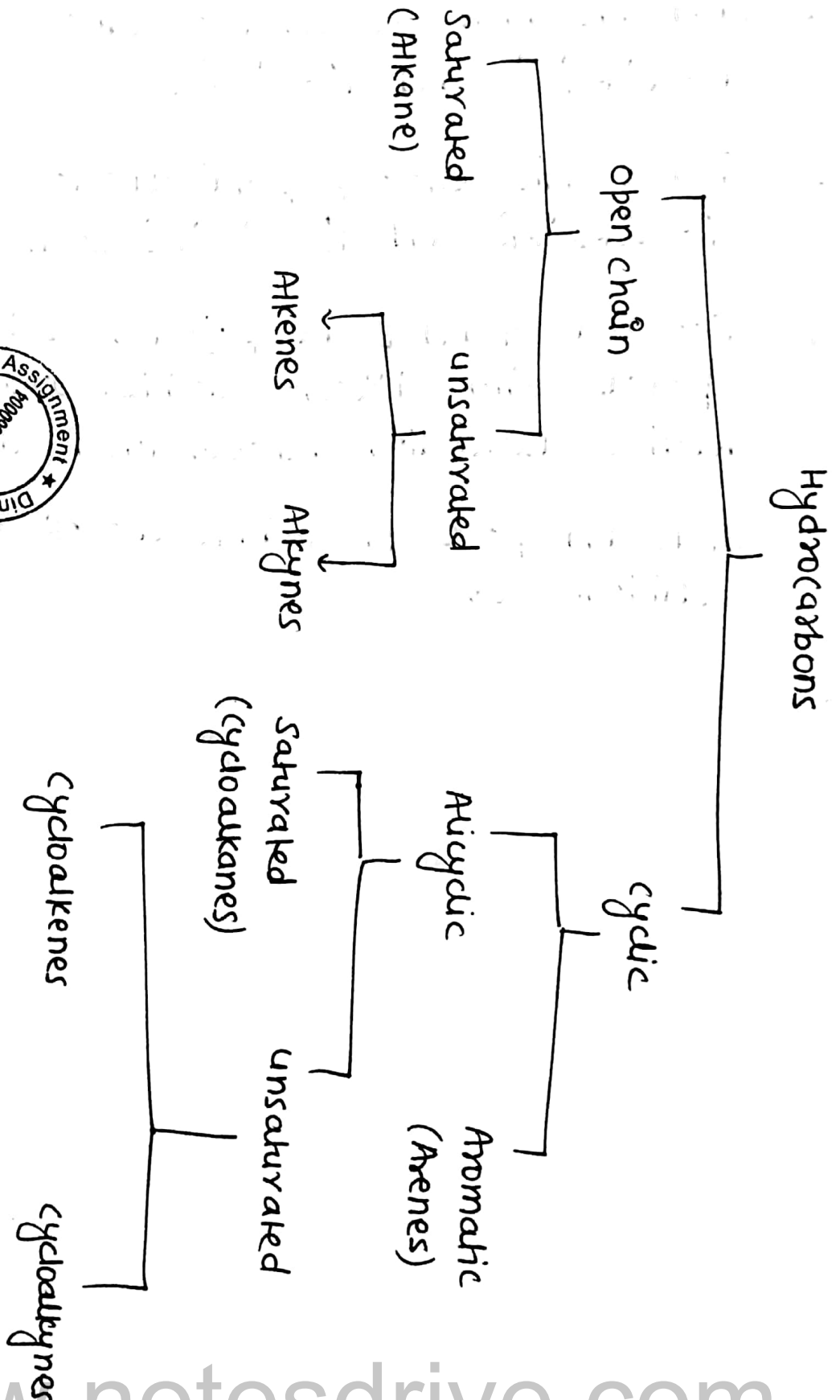


HYDROCARBON

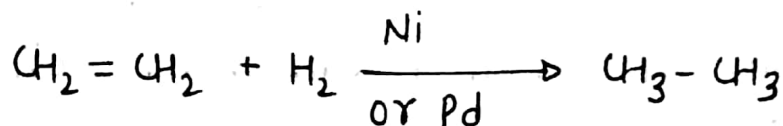
The simplest organic compounds containing carbon and hydrogen only are called hydrocarbons.



Alkanes (C_nH_{2n+2})

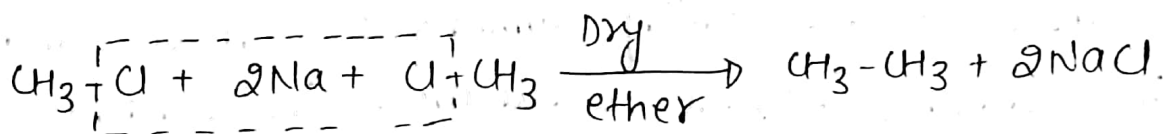
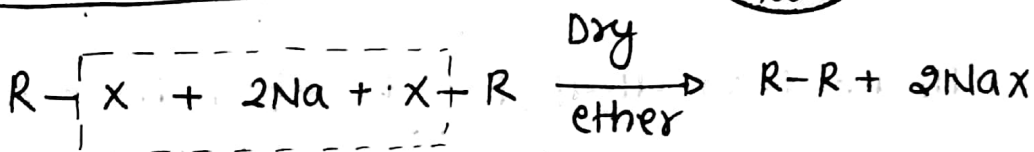
① Preparation

→ from unsaturated hydrocarbons



this Rxⁿ is used to prepare Vanaspathi Ghee from edible vegetable oils.

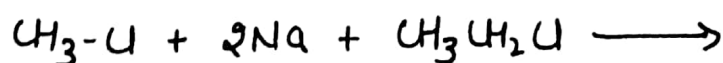
→ Wurtz Reaction



- It doubles the no of carbon atom in the chain.
- Used to prepare an even no of carbon atoms chain.

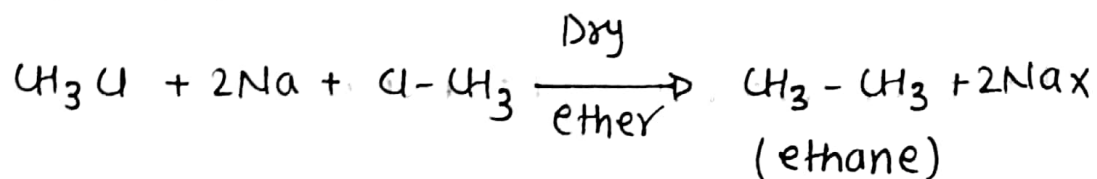
Limitation of Wurtz

→ Cannot be used to prepare odd no of carbon atom chain. E.g

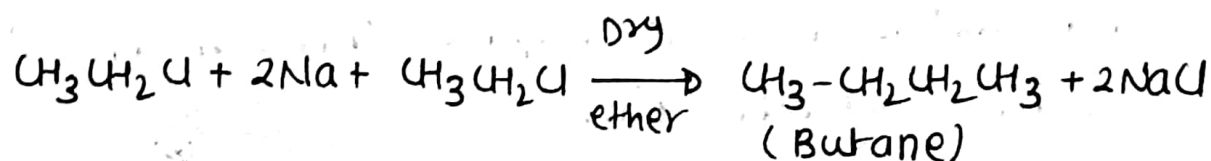


There are 3 possibilities

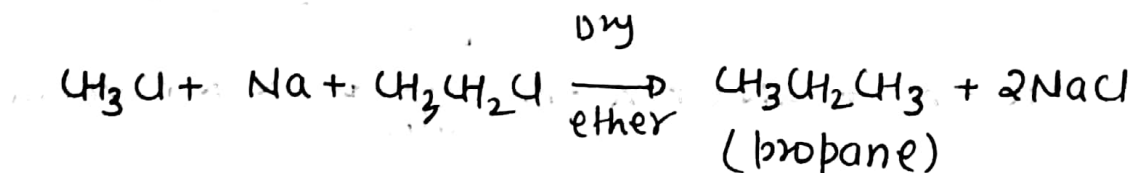
- (i) Two molecules of CH_3Cl can react with each other



- (ii) Two molecules of $\text{CH}_3\text{CH}_2\text{Cl}$ can react with each other.



- (iii) molecule of CH_3Cl can react with molecule of $\text{CH}_3\text{CH}_2\text{Cl}$.



So here we are getting mixture of three alkanes i.e. ethane, propane & butane. The boiling points of these alkanes are very close and hence they cannot be separated by even fractional distillation.

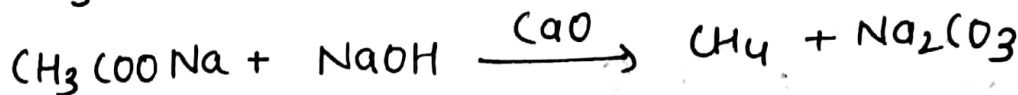
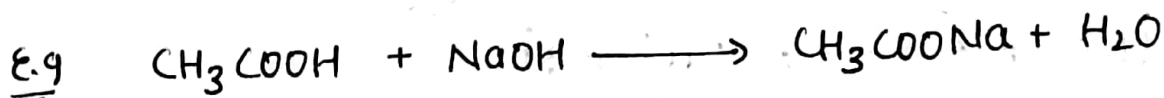
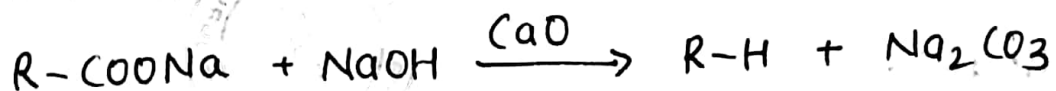
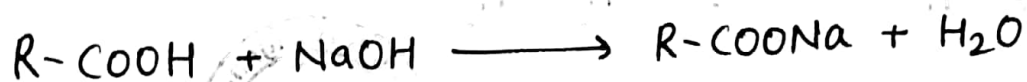
Hence wurtz Rx^n is not used to prepare a carbon chain containing odd no of carbon atoms.



Role of Dry ether in wurtz Rxⁿ

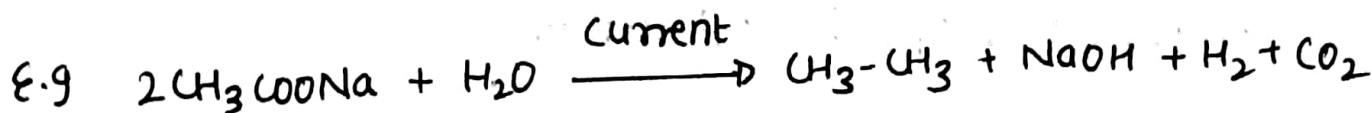
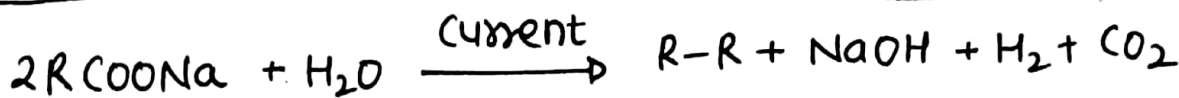
Wurtz Reaction is carried out with sodium metal which is highly reactive, hence we need to select a solvent which will not react with sodium metal. Thus ether becomes the best choice. Dry ether is a very good solvent and provide medium for the Rxⁿ.

→ Decarboxylation Rxⁿ (Removal of COOH Group)
(CO₂)



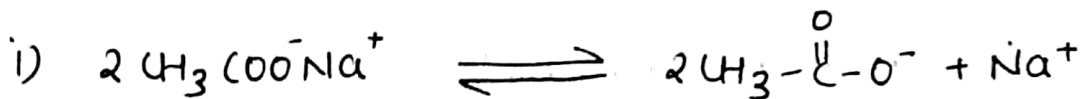
(NaOH + CaO) is known as soda lime

→ Kolbe's electrolytic method

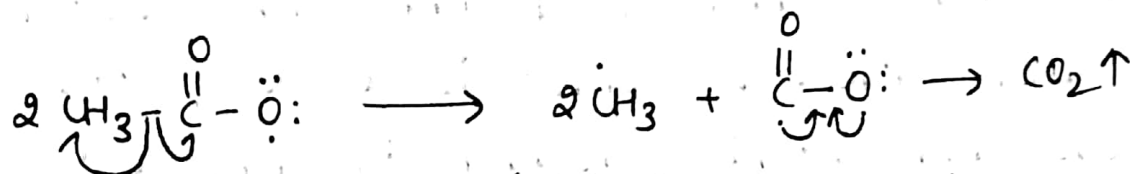
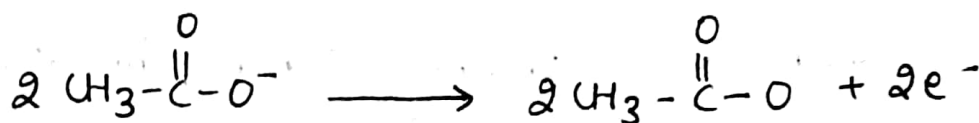


Mechanism: -





At anode:-

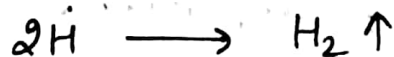
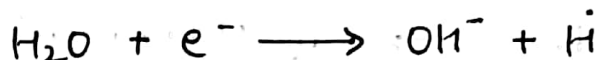


(Acetate ion)

(Methyl free radical)



At cathode:-



Limitation:- methane can not be prepared.

→ This Rxⁿ can not be used to prepare carbon chain of odd no of carbon atoms.

② Physical Properties of alkanes

NO. OF Carbon atom & boiling point

IF two compound contain same no C-atom then

Boiling point ∝ $\frac{1}{\text{no of side chain}}$

Q Arrange them in \uparrow order of their boiling point.

(i) pentane, Isopentane, Neopentane.

① pentane \rightarrow $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$ (No Branch)

Isopentane \rightarrow $\begin{array}{c} \text{CH}_3 - \text{CH} - \text{CH}_2\text{CH}_3 \\ | \\ \text{CH}_3 \end{array}$ (1 Branch)

neopentane \rightarrow $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3 - \text{C} - \text{CH}_3 \\ | \\ \text{CH}_3 \end{array}$ (2 Branch)

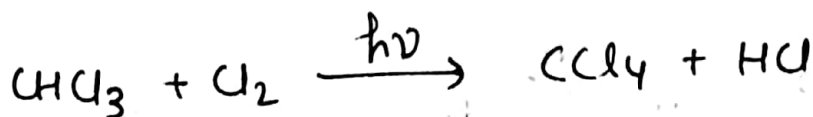
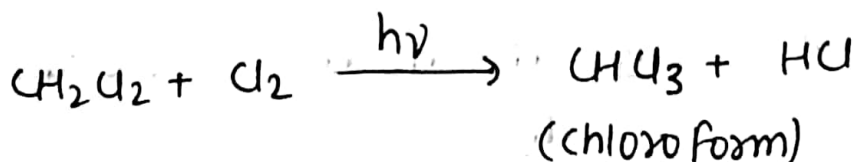
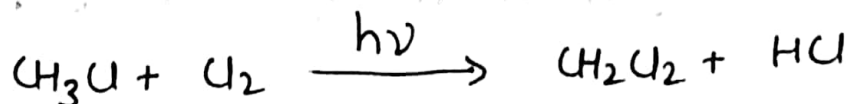
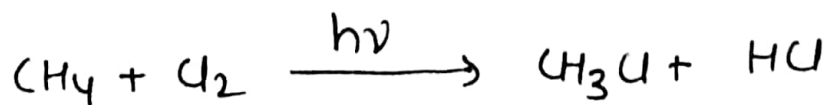
so Boiling point order will be

neopentane $<$ isopentane $<$ pentane.



Chemical Properties of alkane

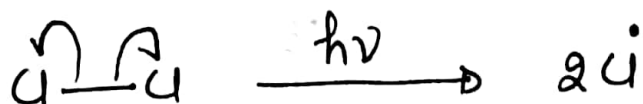
① Chlorination



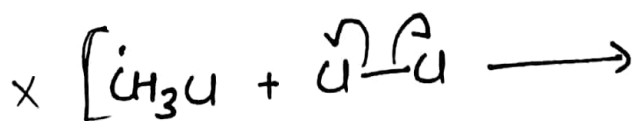
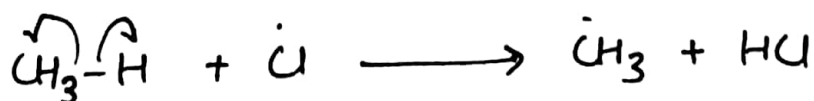
Mechanism: -

→ It follows free radical mechanism which involves 3 steps.

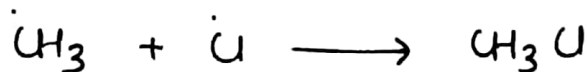
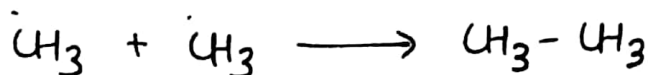
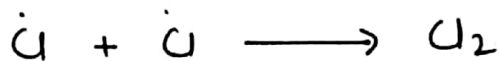
① Initiation



② Chain Propagation

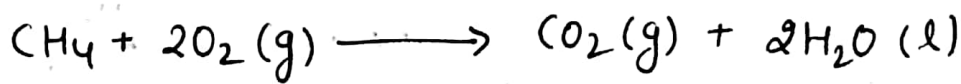


③ chain termination

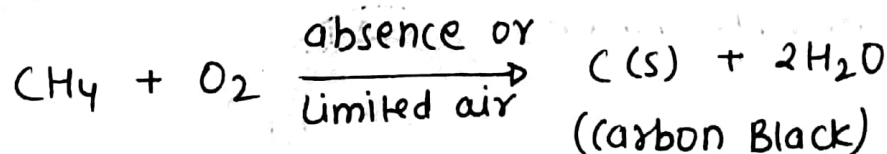


② Combustion

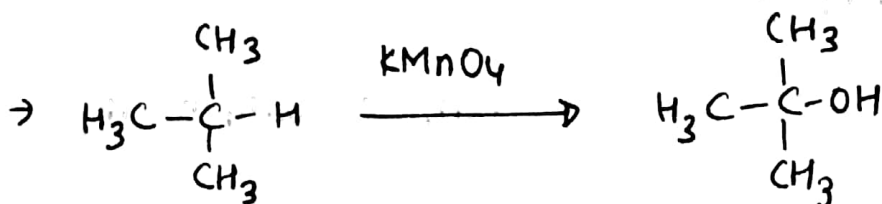
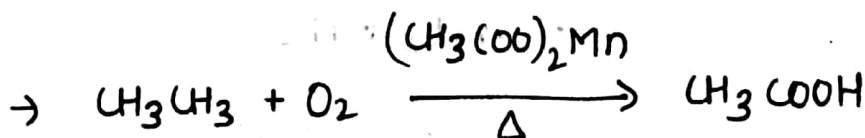
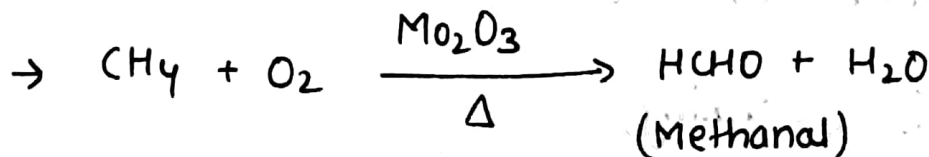
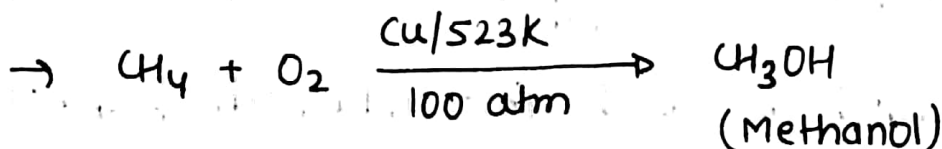
① Complete combustion



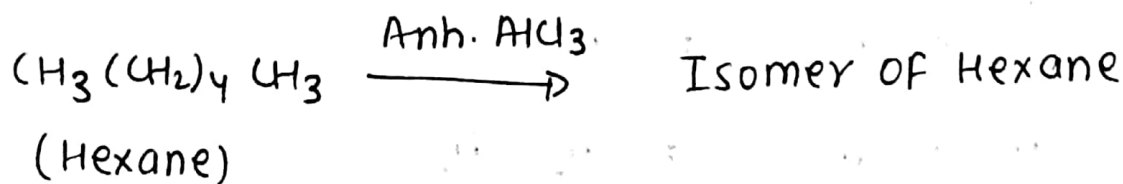
② Incomplete combustion



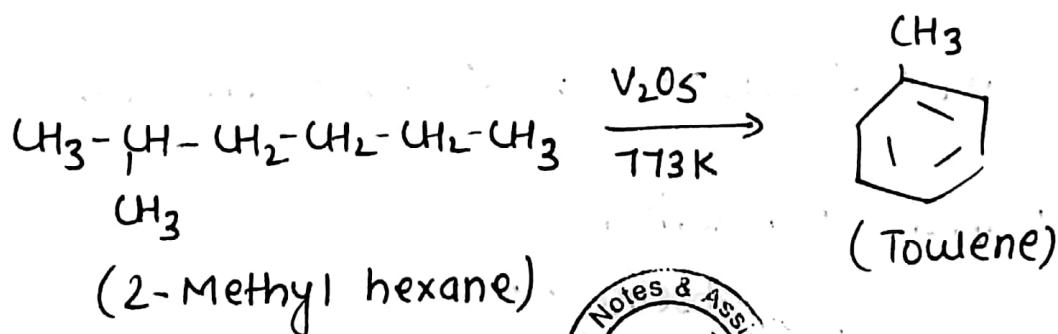
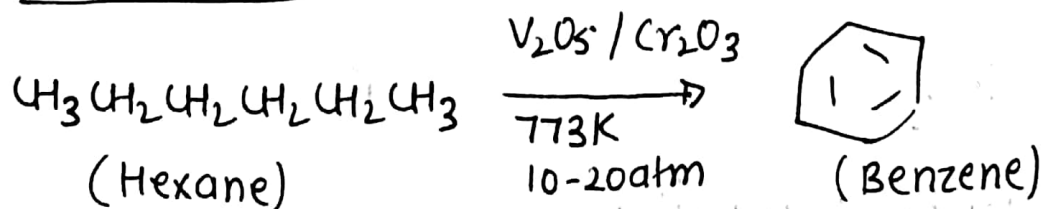
③ Controlled combustion oxidation



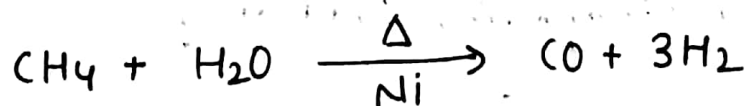
④ Isomerisation



⑤ Aromatization

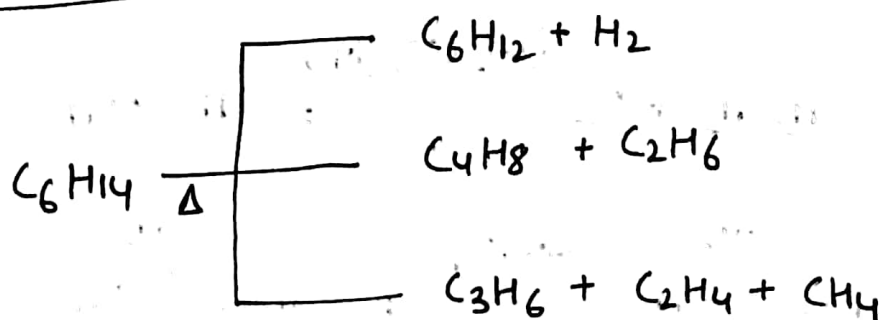


⑥ Reaction with steam



This method is used for industrial preparation of dihydrogen gas.

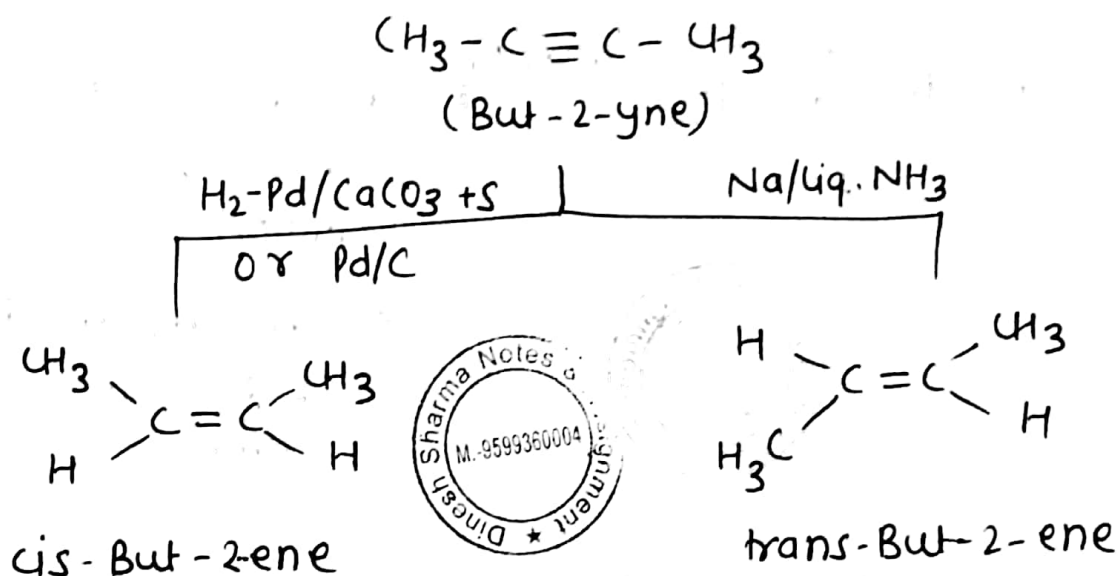
⑦ Pyrolysis (Cracking)



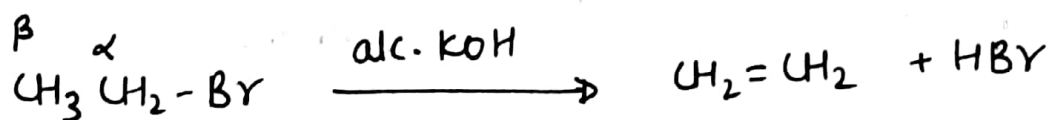
Alkene (C_nH_{2n})

Preparation

① from alkynes



② from alkyl halides (β -elimination R_x^n)

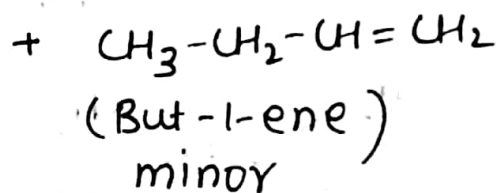
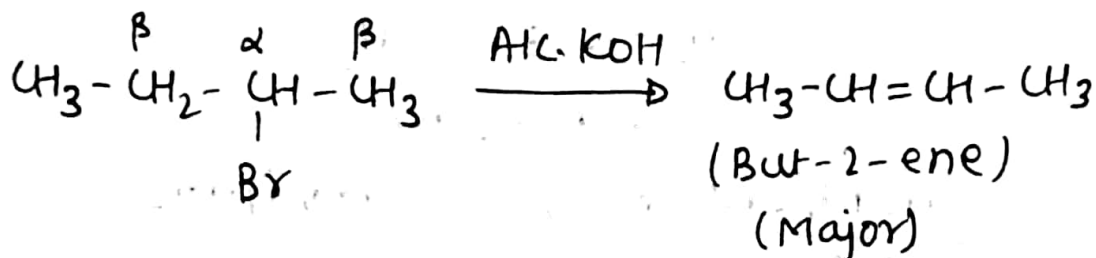


from α -carbon there is a removal of Halogen atom & from β -carbon there is a removal of Hydrogen atom.

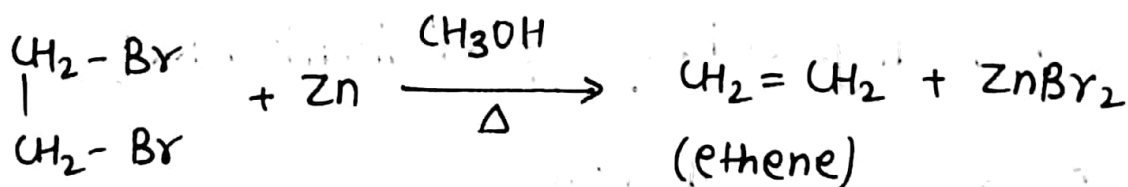
→ This R_x^n is also known as dehydrohalogenation.

Saytzeff rule:- when there are α - β carbon then removal of Hydrogen takes place from that β carbon which contains lesser no of hydrogen atoms.

E.g

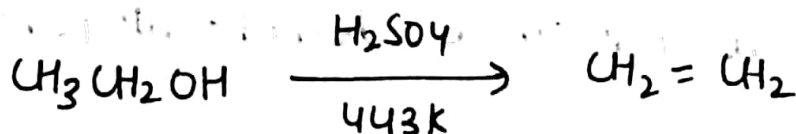


③ From vicinal dihalides



④ from alcohols (Dehydration)

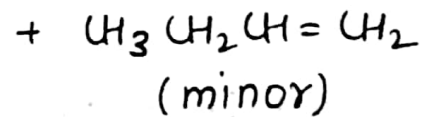
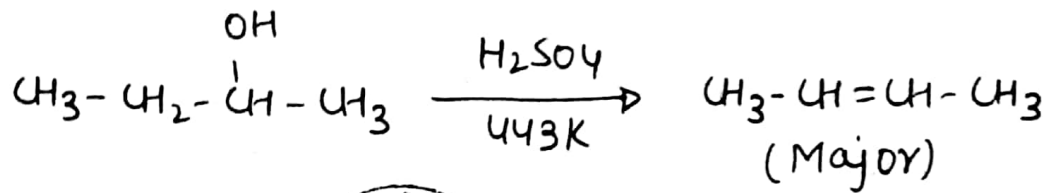
Dehydration :- Removal of H_2O .



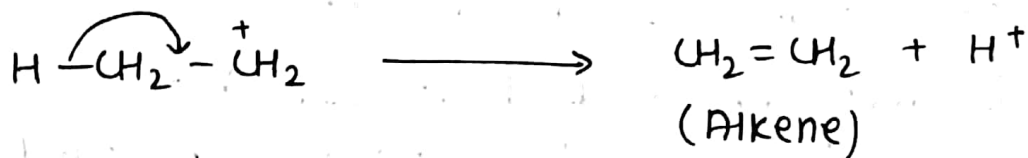
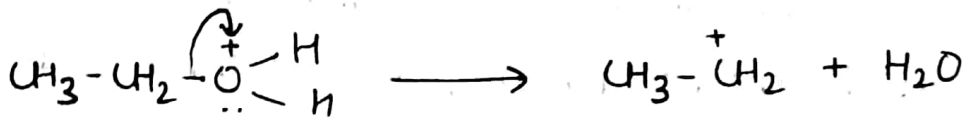
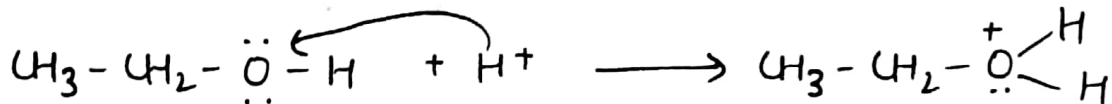
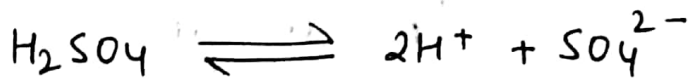
→ Remove OH from α -Carbon and H from β carbon.

→ IF there are more than one β -Carbon then follow Saytzeff rule.

E.g

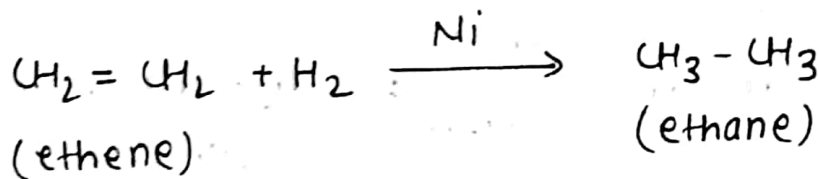


Mechanism: -

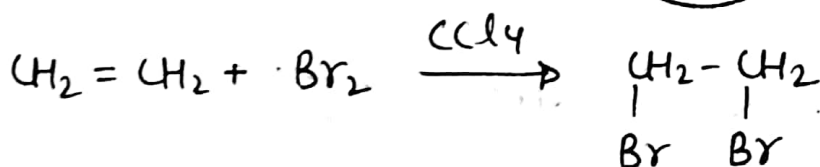


Chemical Properties of Alkenes

① Addition of H₂



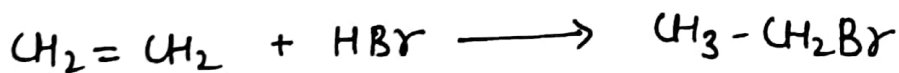
② Addition of Halogens



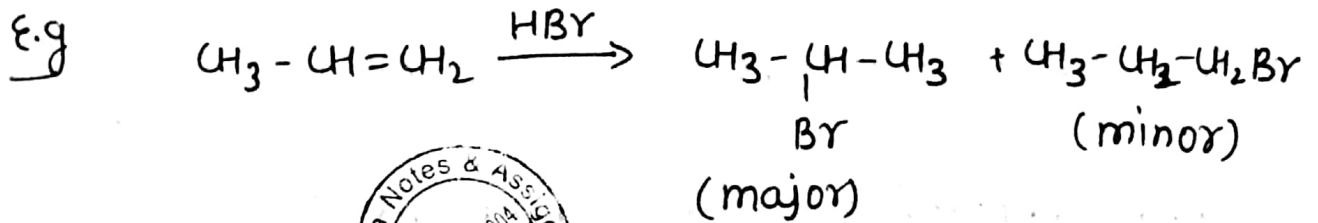
★ During the addition of bromine to the unsaturated hydrocarbons, the orange red colour of bromine is discharged.

Hence this Rxⁿ can be used to test for unsaturation in the given organic compound.

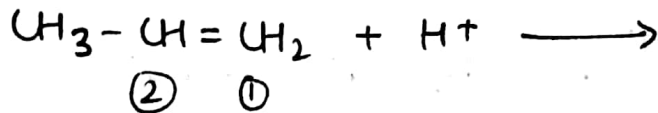
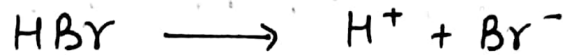
③ Addition of Hydrogen halide (HX)



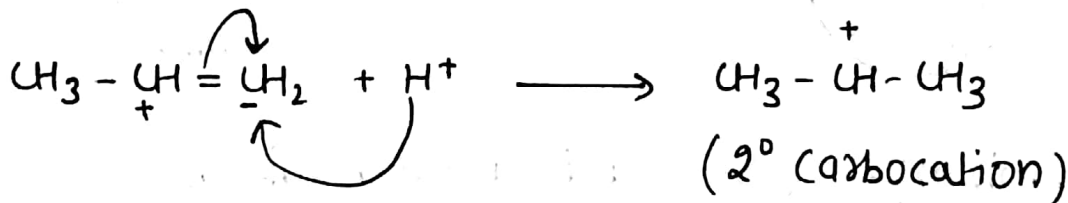
Markovnikov's Rule :- Halogen atom goes to that double bonded carbon atom which contain lesser no. of hydrogen.



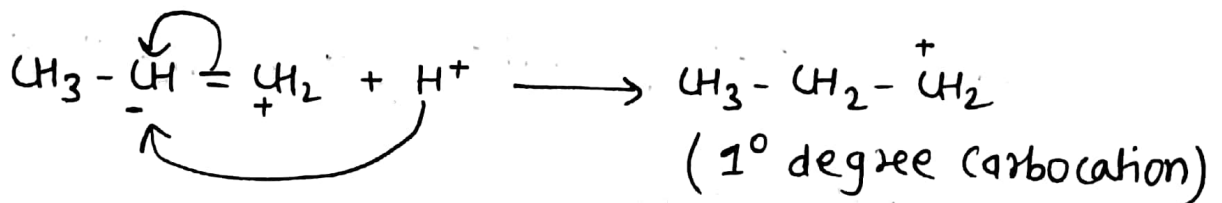
Mechanism: -



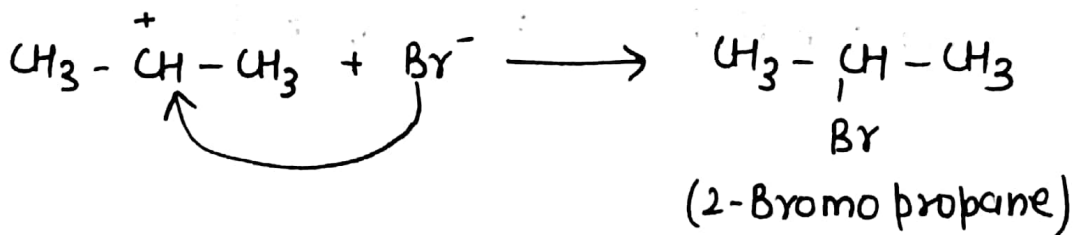
There are two cases i) when double bond is shifted to ① carbon.



(ii) when double bond is shifted to ② carbon.



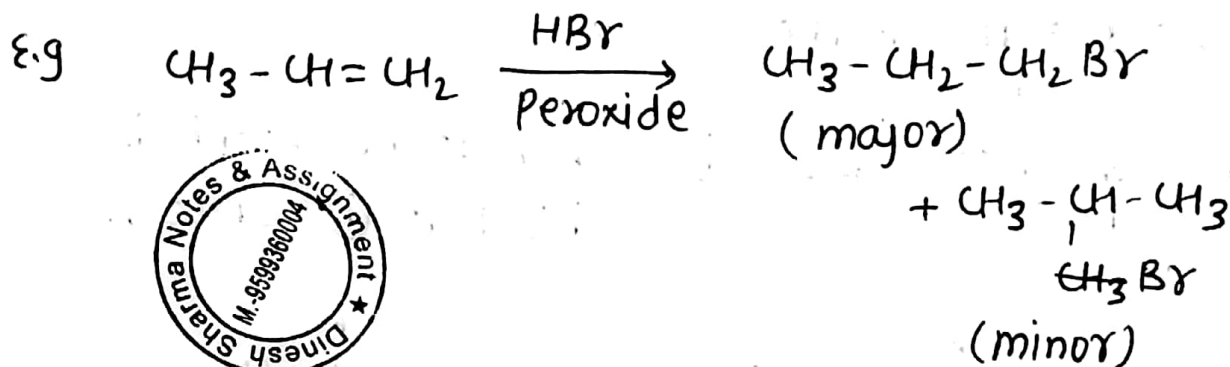
We know that 2° carbocation is more stable than 1°. So further attacks will take place on 2° carbocation.



④ Addition of HX in presence of peroxide

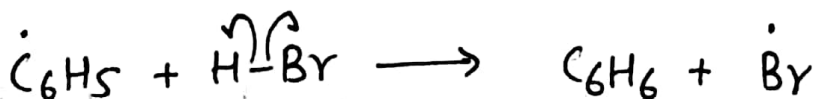
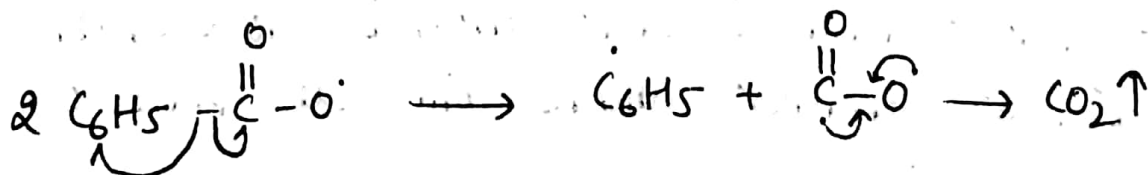
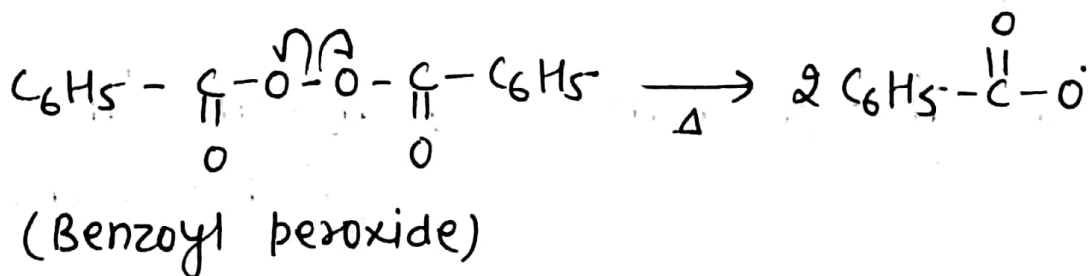
anti-markovnikov's Rule / Kharasch effect :-

Halogen atom goes to that double bonded carbon atom which contains more no of hydrogen atoms.

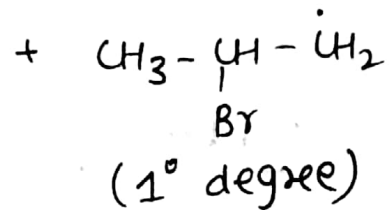
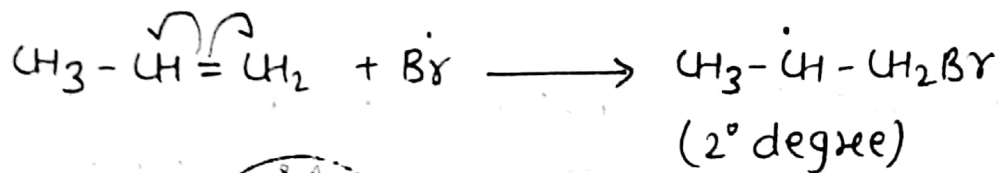


Mechanism:- (free radical mechanism)

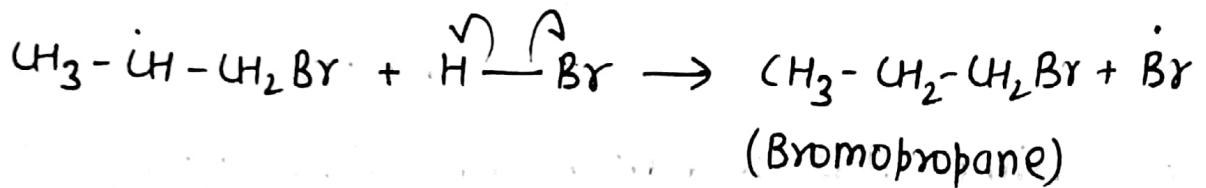
① Initiation



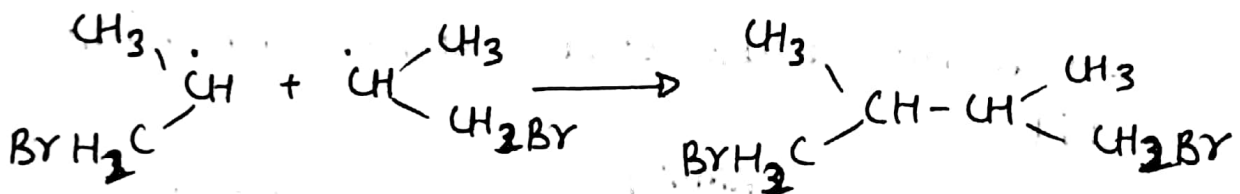
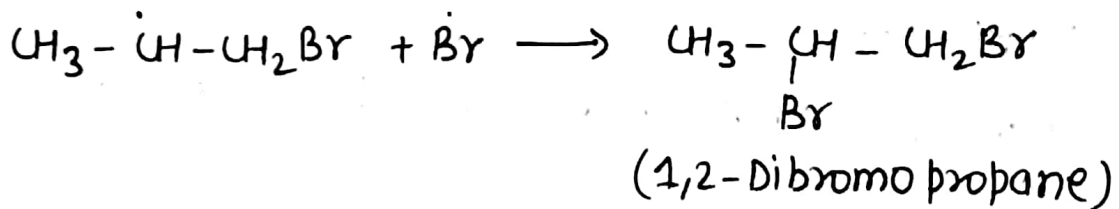
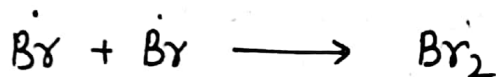
2) Propagation



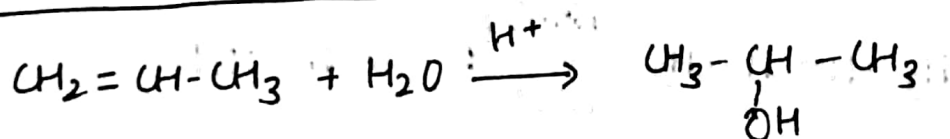
We know that 2° radical is more stable.



3) Termination

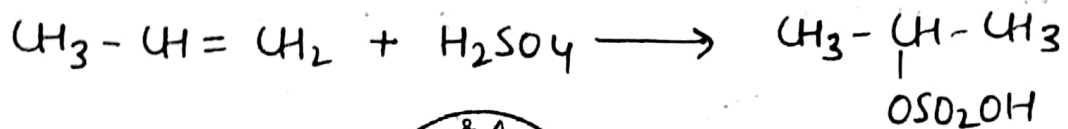


5) Addition of water

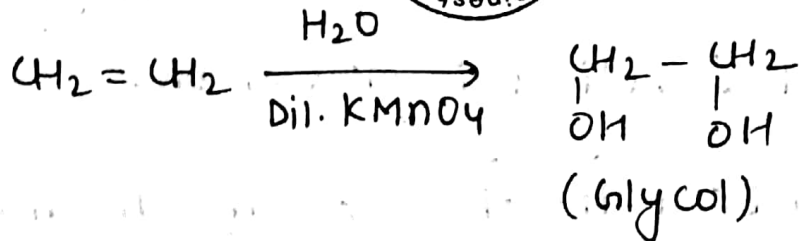


Add OH & H acc. to Markovnikov's rule.

⑥ Addition of H₂SO₄



⑦ Oxidation

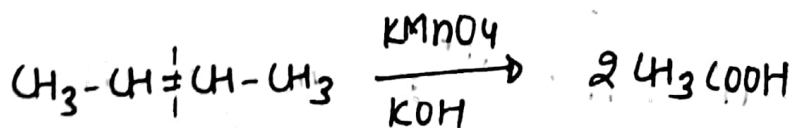
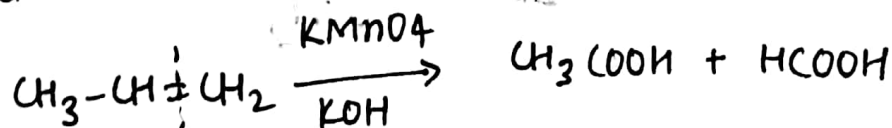


* During this reaction the pink colour of KMnO₄ solⁿ is discharged and a brown ppt is obtained. Hence this Rxⁿ can be used to test unsaturation in the organic compound.

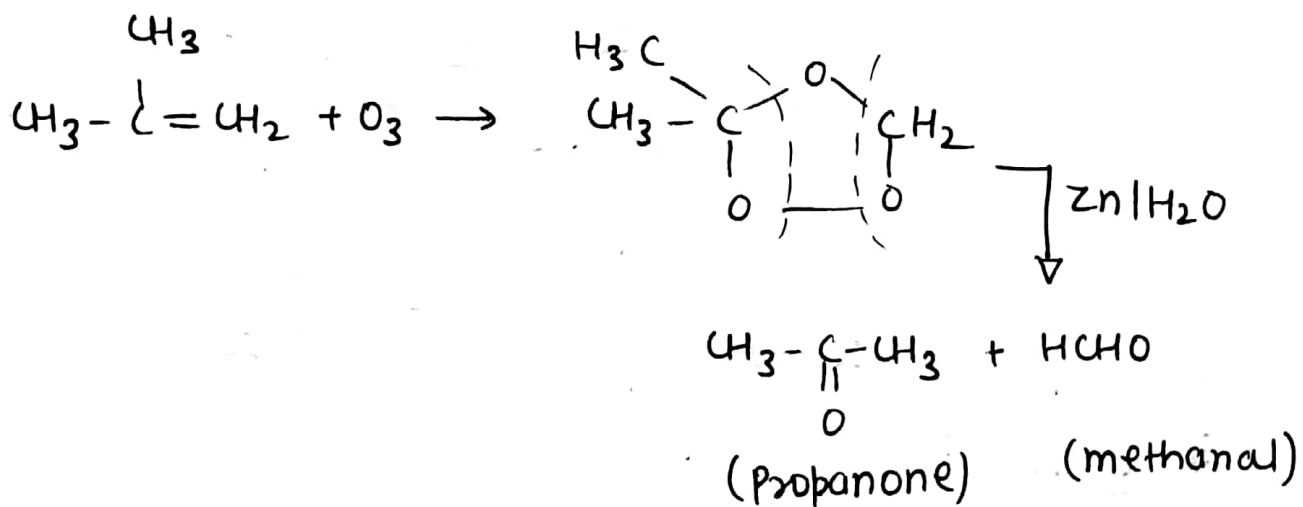
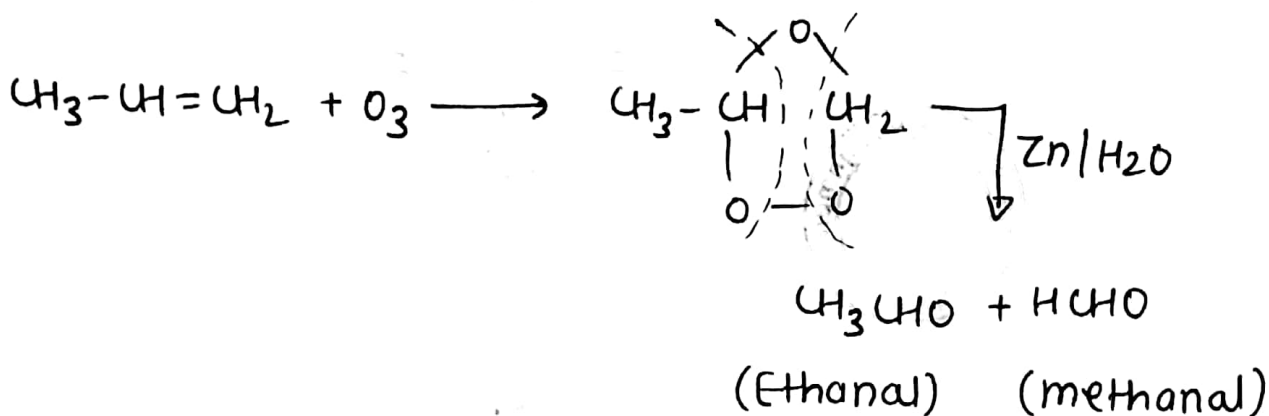
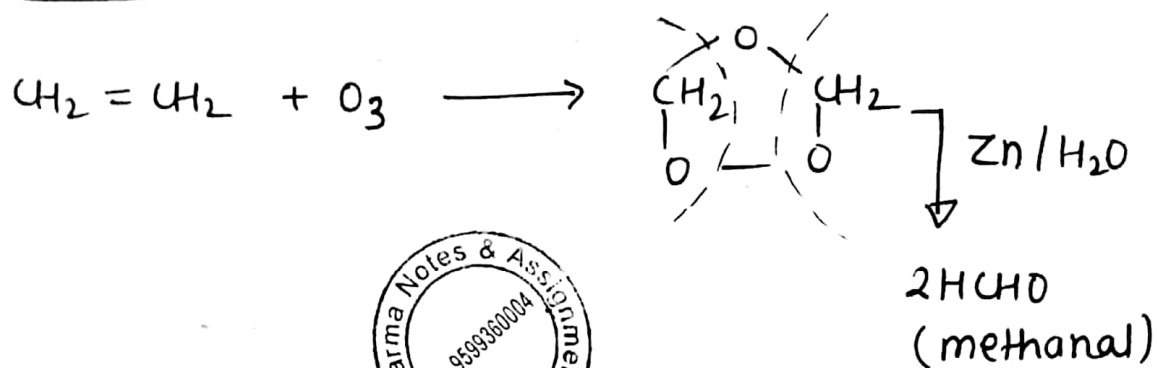
* KMnO₄ is known as Baeyer's Reagent.

Oxidation with Hot KMnO₄

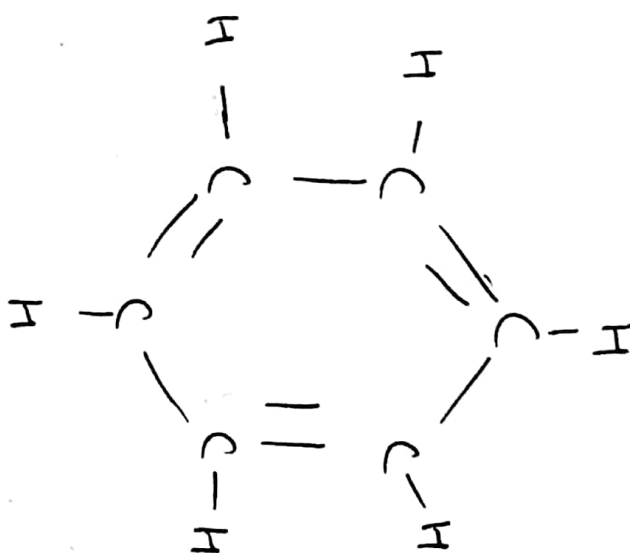
→ Break the double bond & converts them into acid



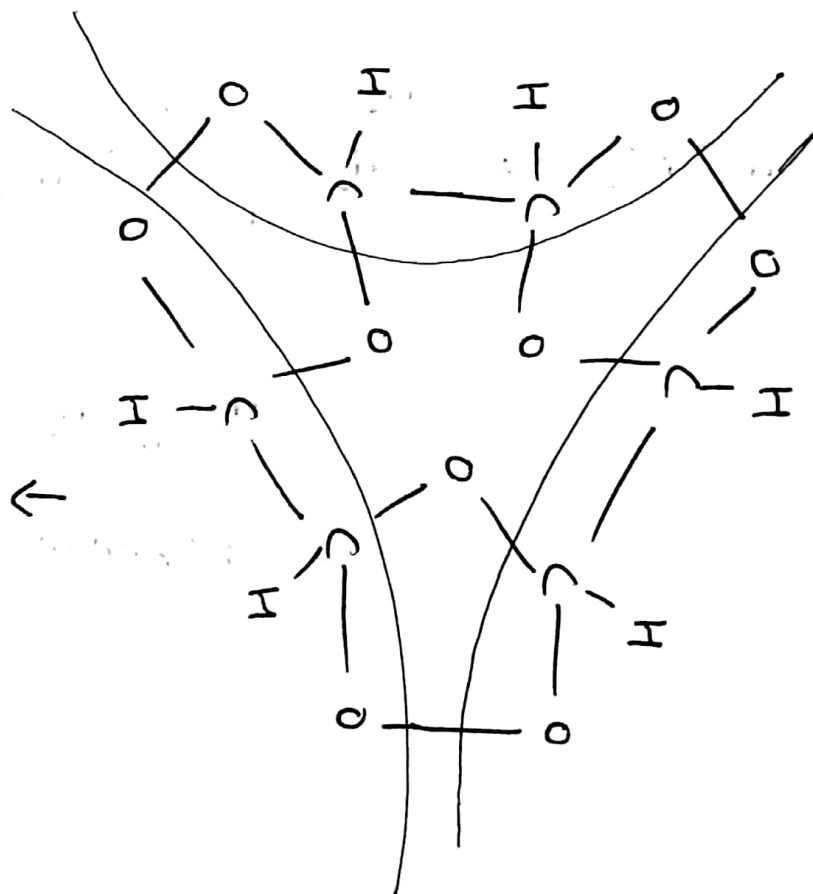
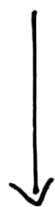
⑧ Ozonolysis (Addition of ozone)



Ozonolysis of Benzene

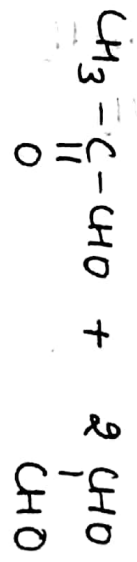
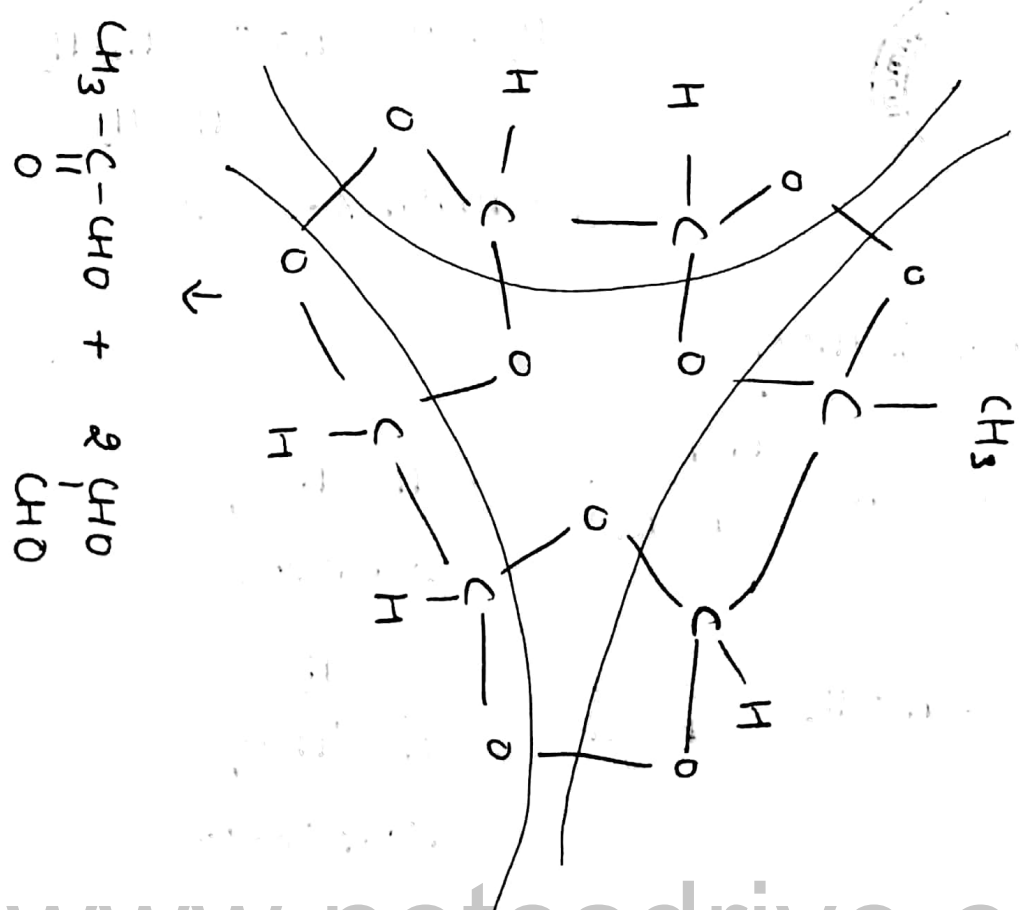
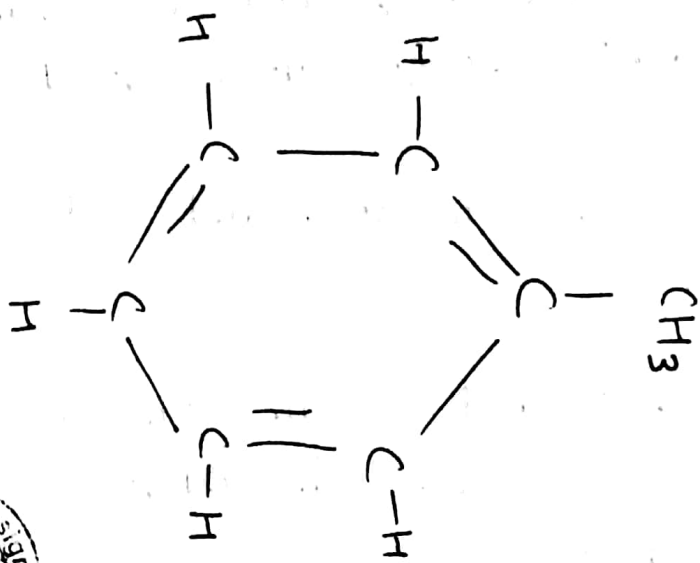


+3O₃



3 - CHO
(Ethane-1,2-dial)

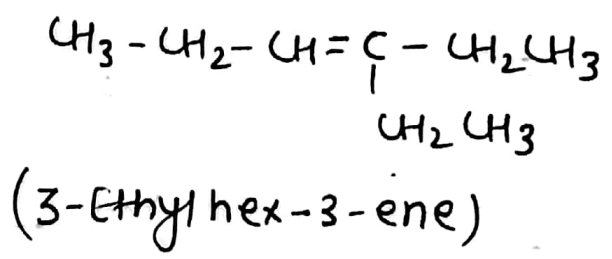
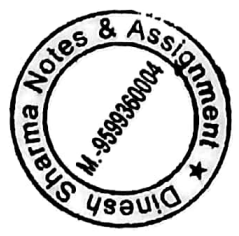
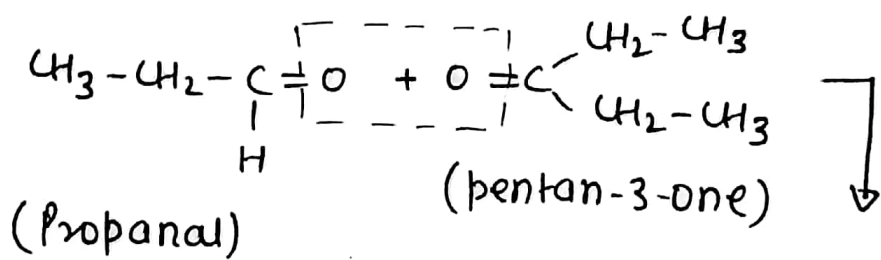
Ozonolysis of Toluene



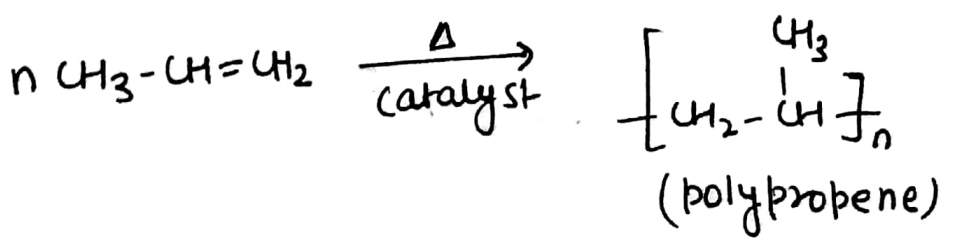
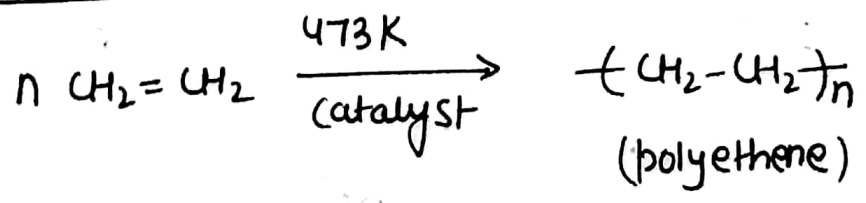
How to write Reactant from the given products of ozonolysis

- Draw structure of products in such a way that their oxygen atom should face each other.
- Replace oxygen atom and add double bond there.

E.g Propanal and pentan-3-one are the products of ozonolysis. Write name & structure of the alkene.



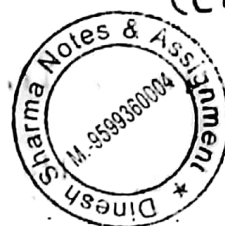
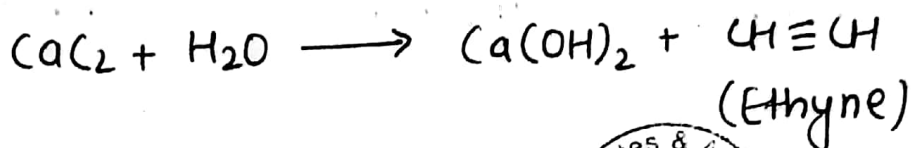
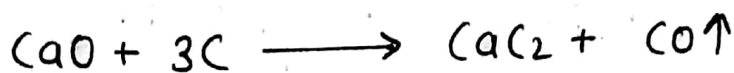
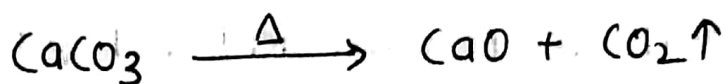
⑨ Polymerisation



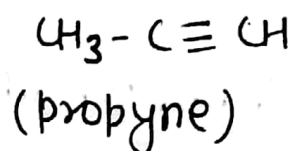
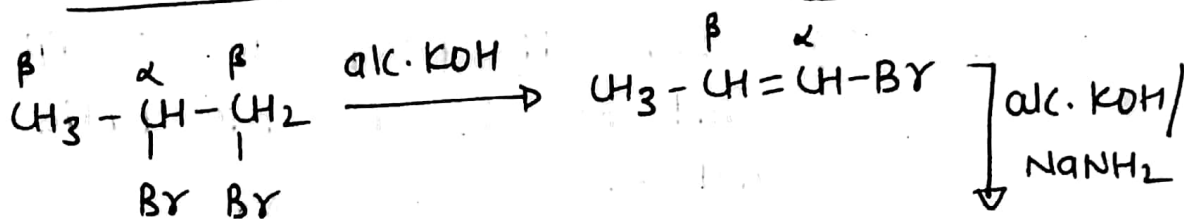
Alkynes (C_nH_{2n-2})

① Preparation

① from calcium carbide

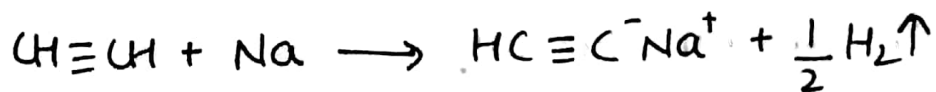


② from vicinal dihalides



Chemical Properties of alkynes

① Acidic nature of alkyne



almost all metal reacts with acid and produce H_2 gas. Since alkyne is also producing H_2 with reactive metal, hence it is acidic in nature.

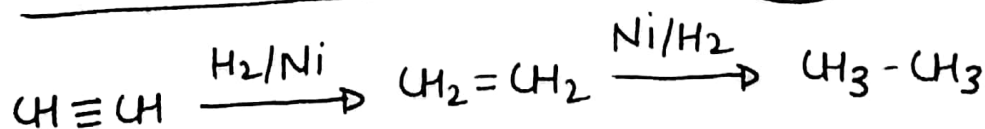
Q Arrange them in \uparrow order of acidic nature.

i) $\text{CH}\equiv\text{CH}$ (ii) $\text{CH}_3-\text{C}\equiv\text{CH}$ (iii) $\text{CH}_3-\text{C}\equiv\text{C}-\text{CH}_3$

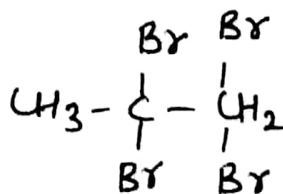
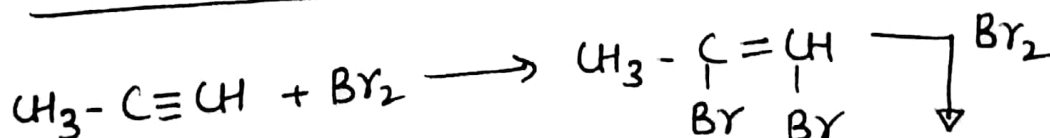
A (3) < (2) < (1) Since CH_3 group has +I effect and +I decreases the acidic nature.



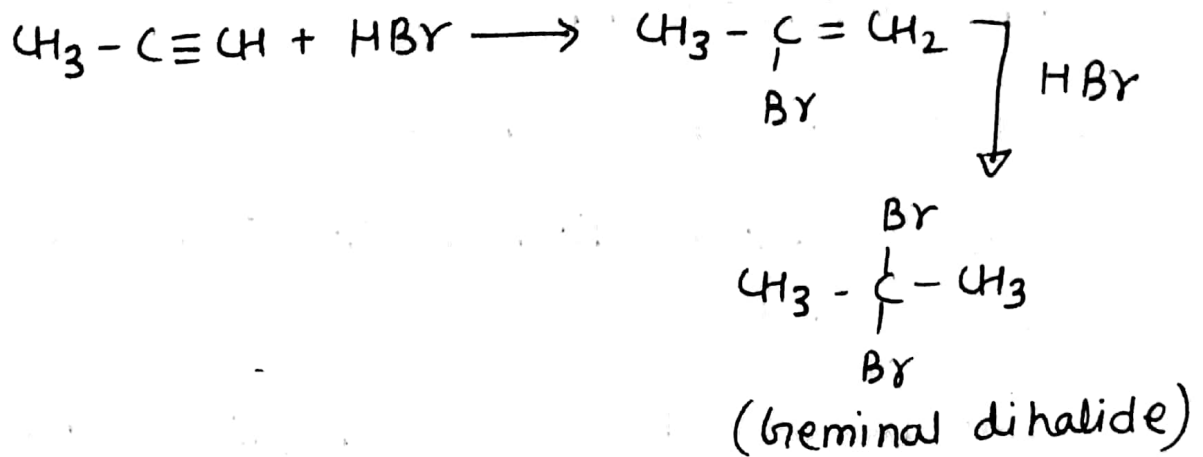
② Addition of H_2



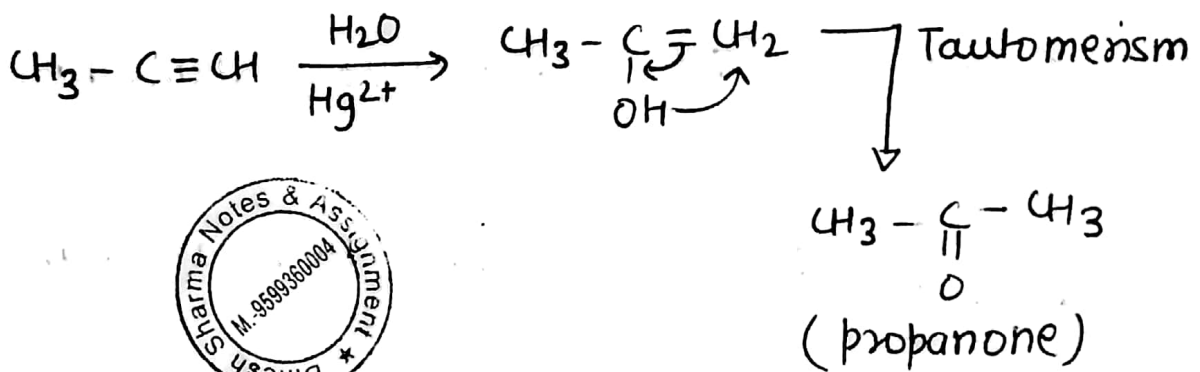
③ Addition of Halogen



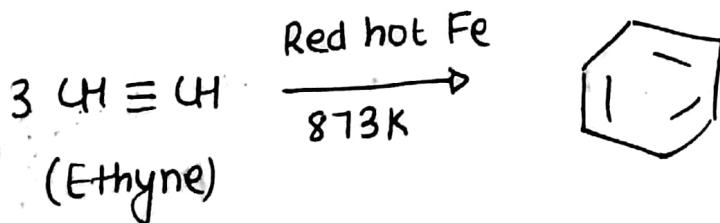
6 (4) Addition of HX



5 (5) Addition of water



6 (6) Polymerisation



Aromatic hydrocarbons

condition for Aromaticity

- ① Structure should be planar.
- ② Complete delocalisation of the π electrons in the ring.
- ③ Structure should contain $(4n+2)\pi$ electrons where $n=0,1,2,...$ (known as Hückel rule)

Q. which of the following compounds are aromatic

(i)



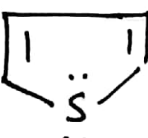
$\pi e^- \Rightarrow 6 \Rightarrow (4(1)+2)$ Hence aromatic

(ii)



$\pi e^- \Rightarrow 6 \Rightarrow (4(1)+2)$ Hence aromatic

(iii)



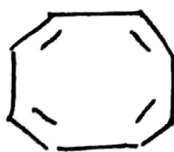
$\pi e^- \Rightarrow 6 \Rightarrow (4(1)+2)$ Hence aromatic

(iv)



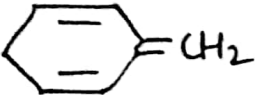
$\pi e^- \Rightarrow 4$ not aromatic


(v)



$\pi e^- \Rightarrow 8$ not aromatic

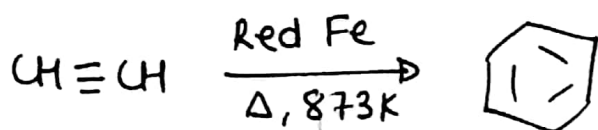


(vi)  not aromatic (missing of conjugation)

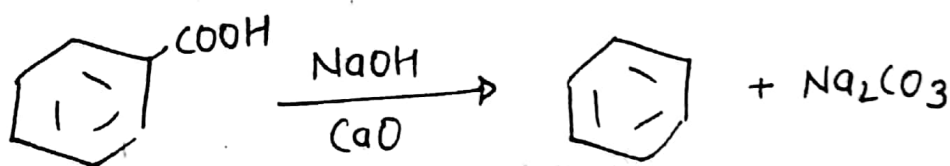
(vii)  not aromatic (missing conjugation)

Preparation of Benzene

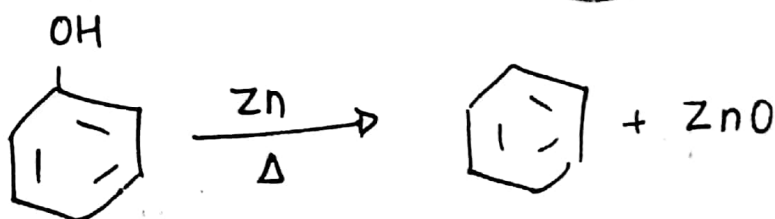
① Polymerisation of ethyne



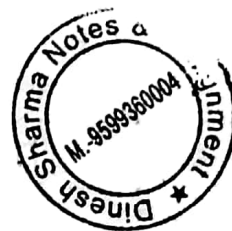
② from Decarboxylation of benzoic acid



③ from phenol

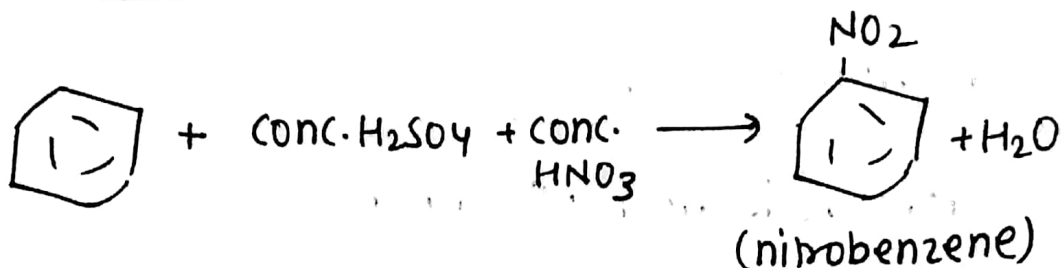


Chemical Properties of Benzene

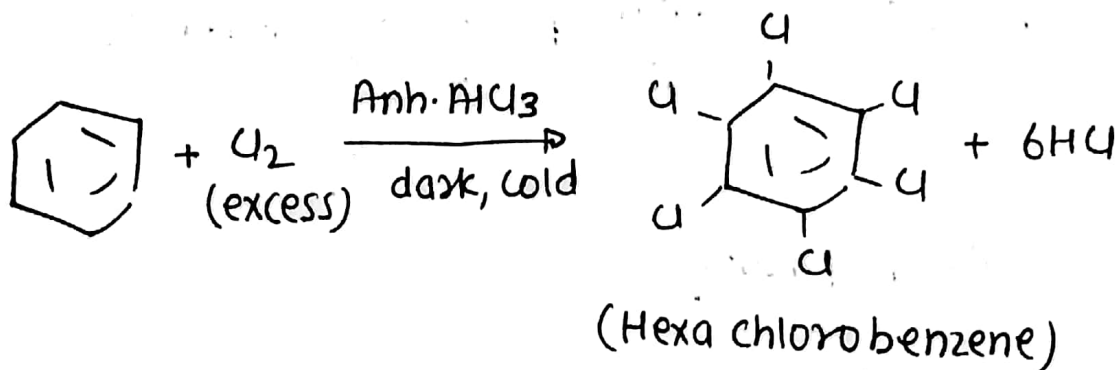
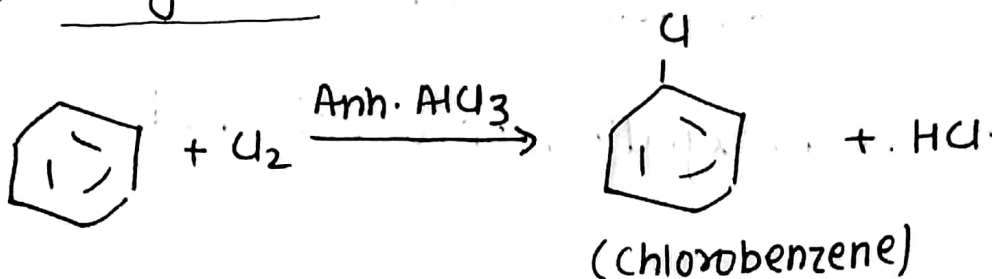


① Electrophilic substitution Rxⁿ

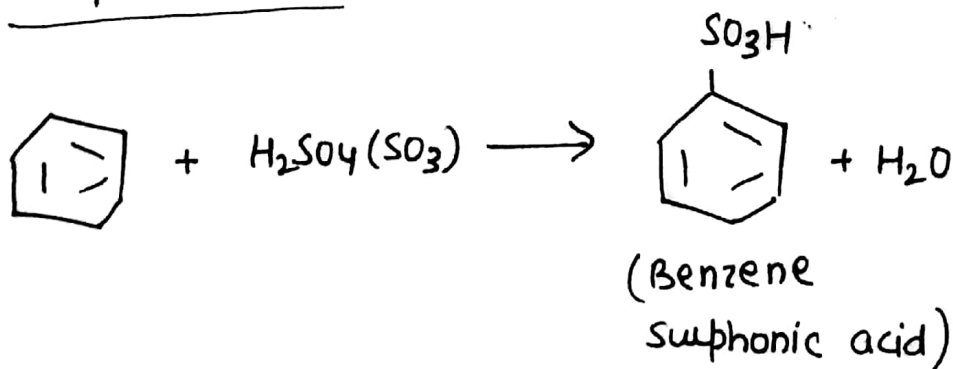
① Nitration



② Halogenation

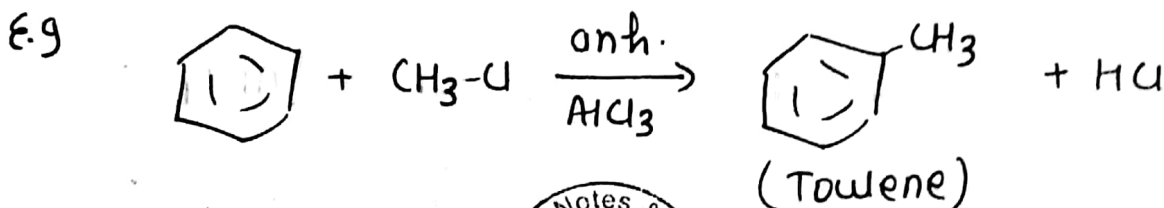
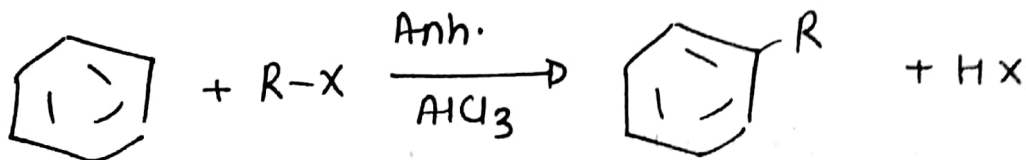


③ Sulphonation

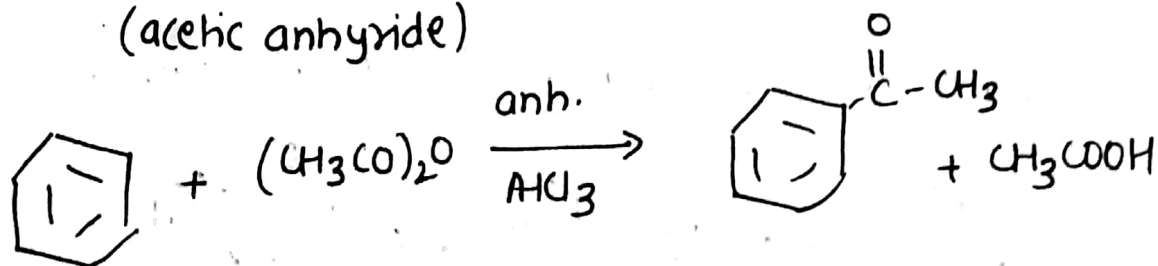
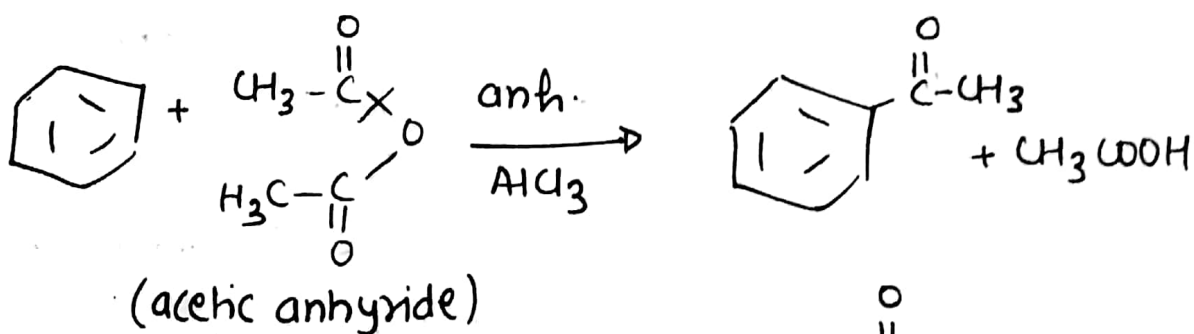
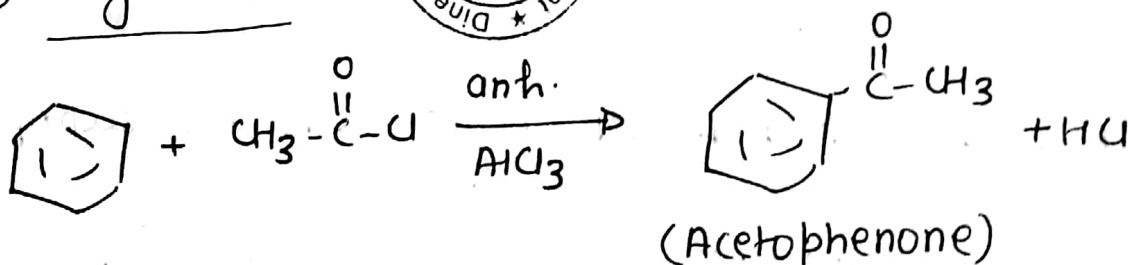


④ Friedel Crafts Rxⁿ

① Alkylation



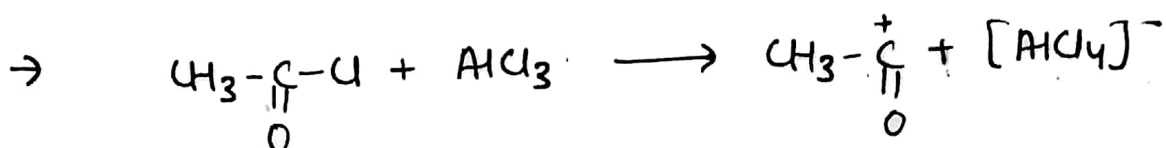
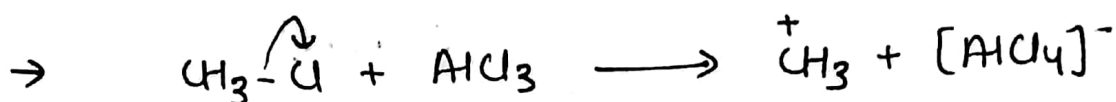
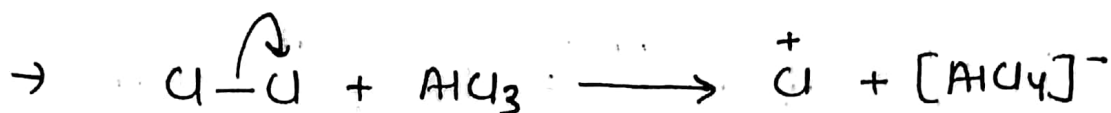
② Acylation



Mechanism of Electrophilic substitution

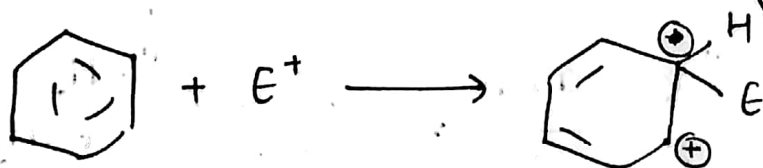
- ① Generation of electrophile (E^+)
- ② Formation of Carbocation intermediate
- ③ Removal of proton (H^+)

① Generation of electrophile (E^+)



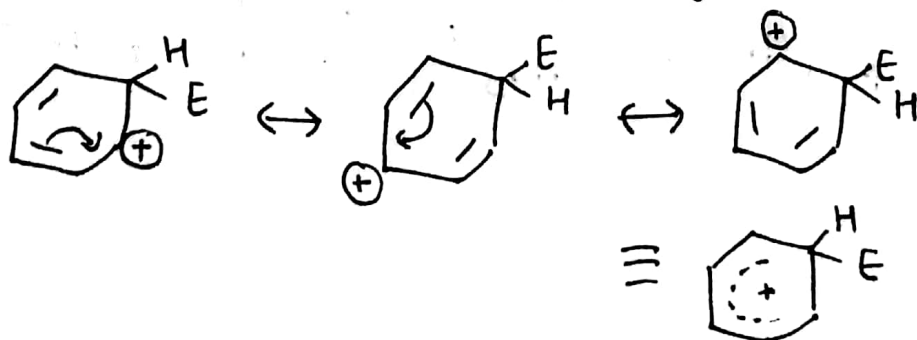
Here role of anh. $AlCl_3$ is to generate electrophile.

② Formation of carbocation

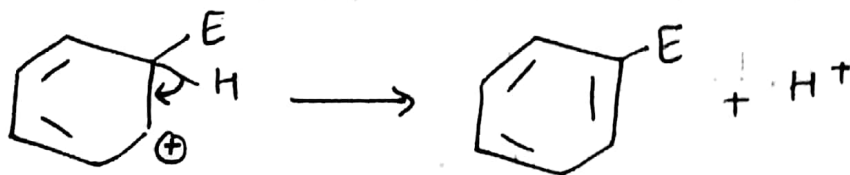


(σ complex/ Arenium ion)

Arenium ion gets stabilised by resonance.



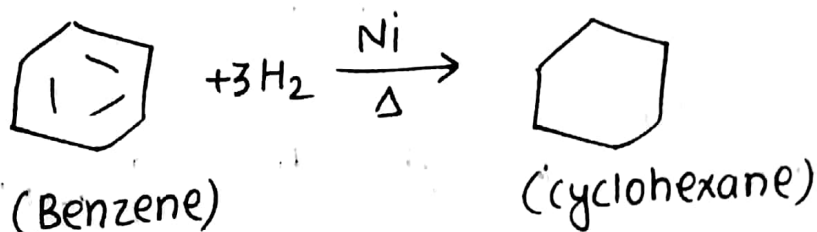
③ Removal of proton (H⁺)



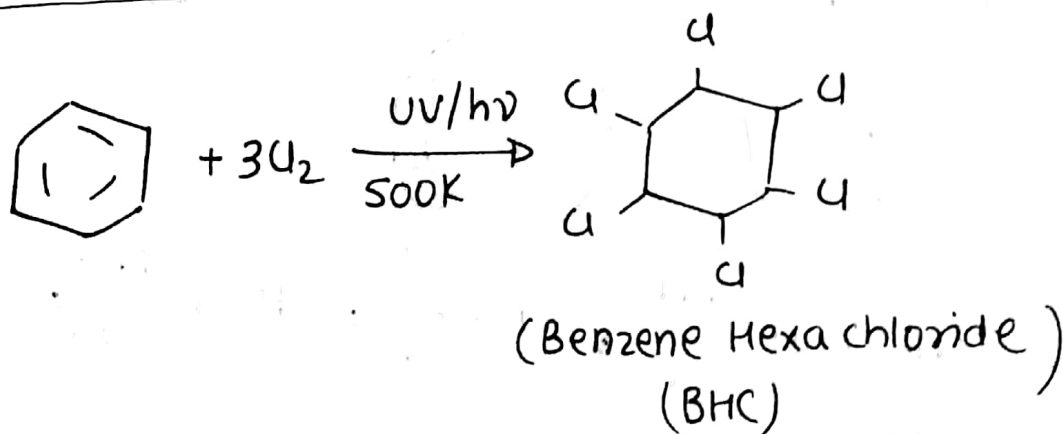
Addition Reaction



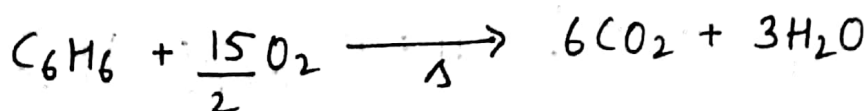
① Addition of H₂



② Addition of Cl₂

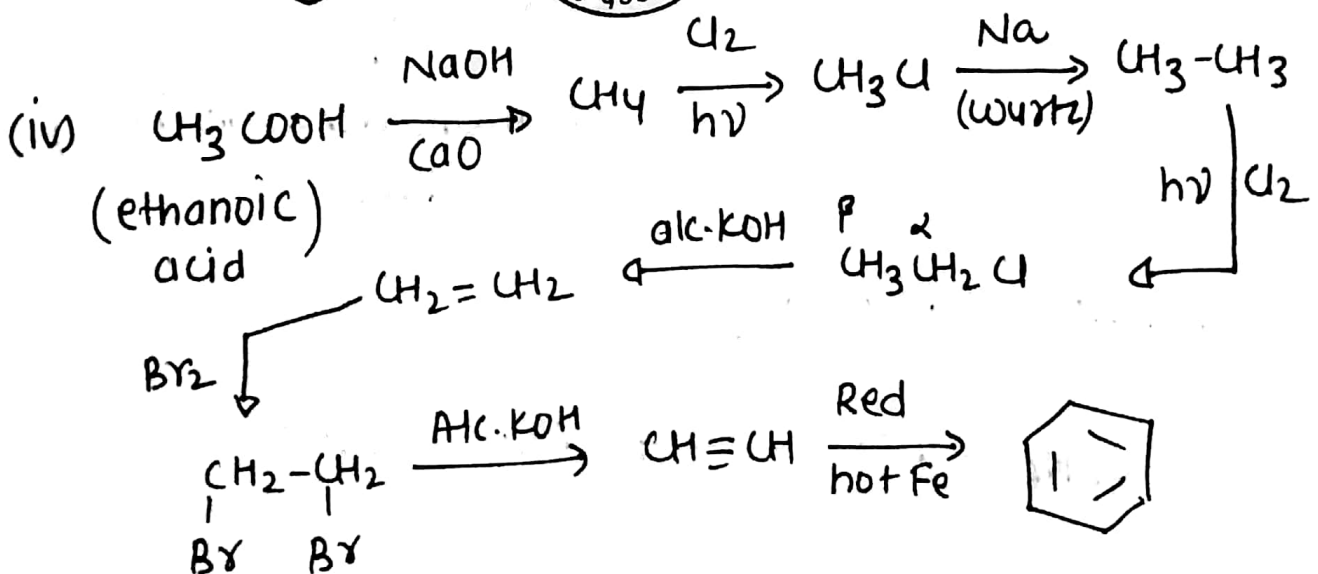
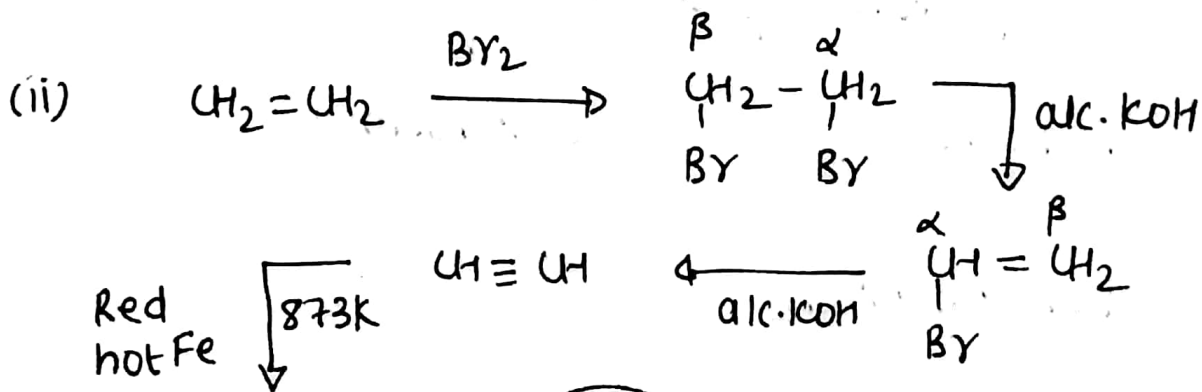
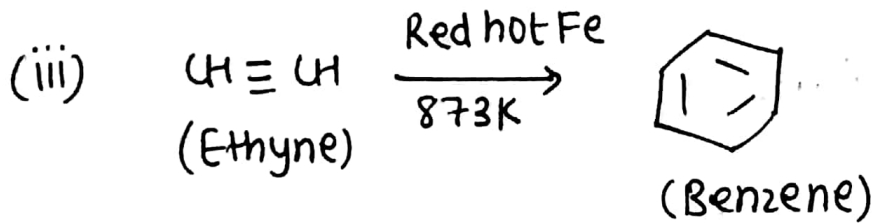
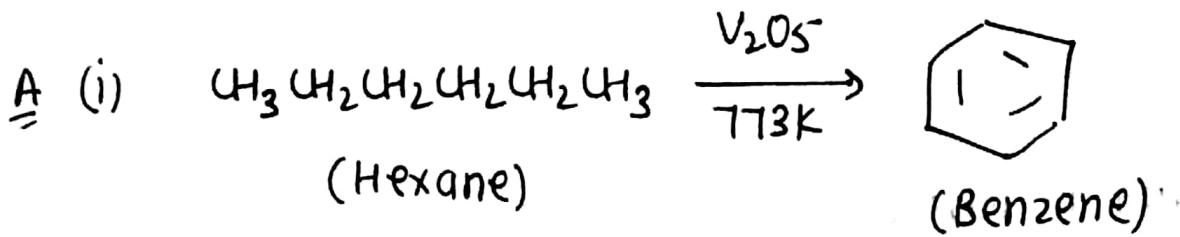


Combustion of Benzene



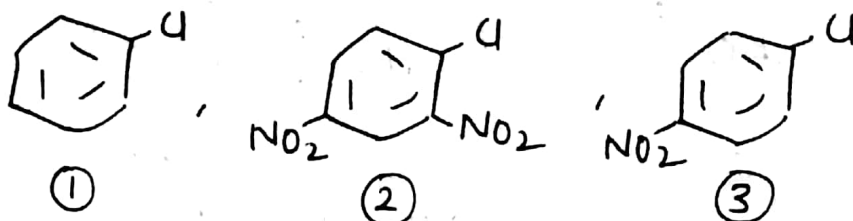
Q Convert following into benzene.

- (i) hexane (ii) ethene (iii) ethyne
(iv) ethanoic acid.



Q Arrange the following set in order of their decreasing reactivity with an electrophile E^+

- (i) chlorobenzene, 2,4-dinitrochlorobenzene
/ p-nitrochlorobenzene

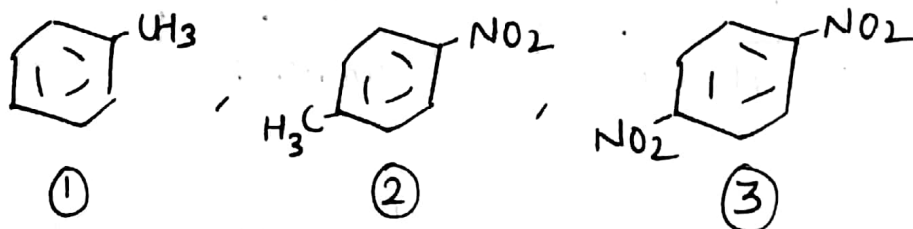


Intermediate is carbocation and we know that
-I effect decreases the stability of carbocation.
(NO_2 has -I effect).

So order is) - ① > ③ > ②



- (ii) Toluene, p- $CH_3-C_6H_4-NO_2$, p- $NO_2-C_6H_4-NO_2$



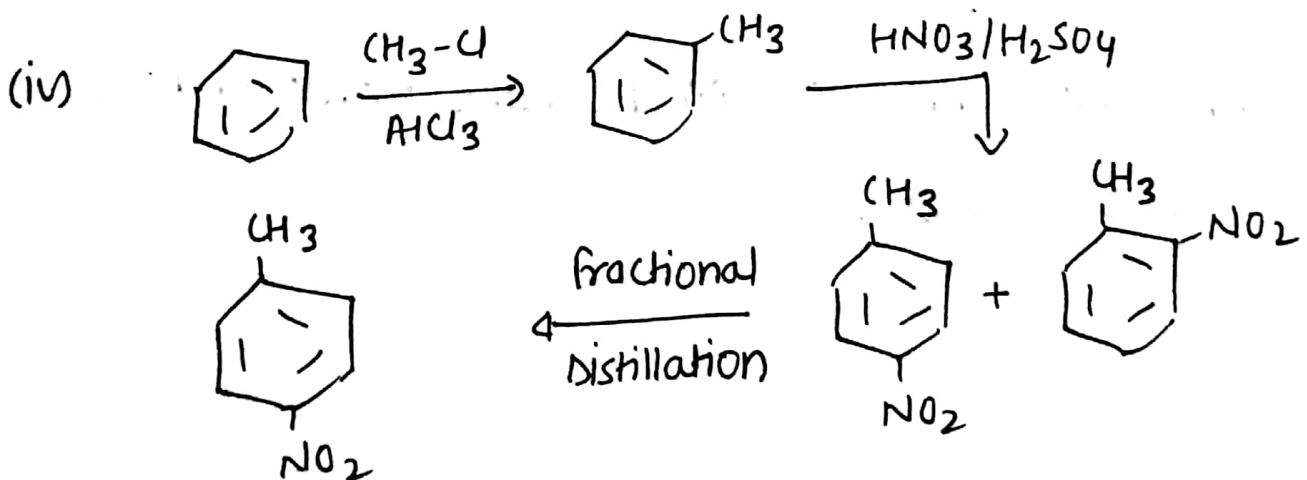
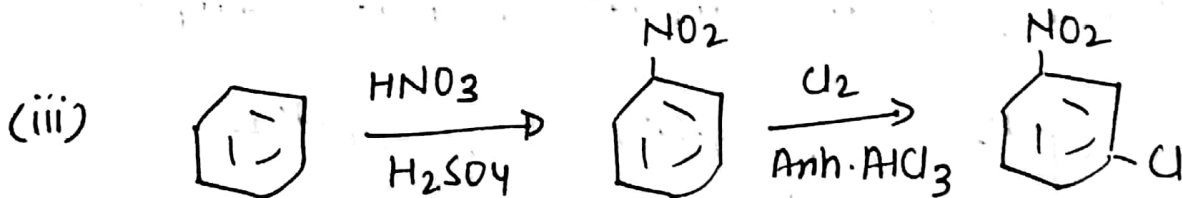
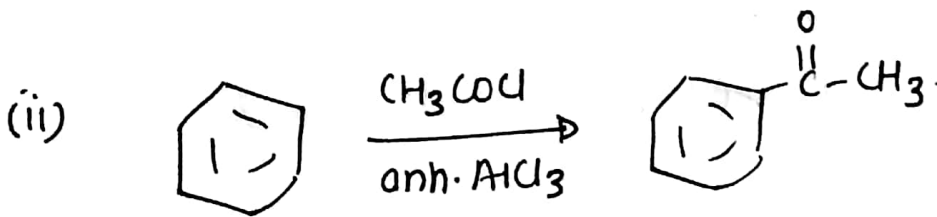
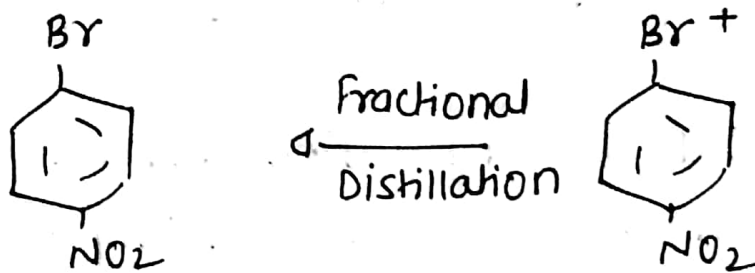
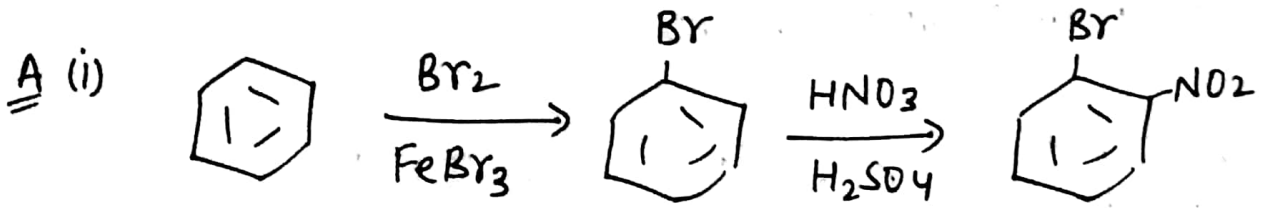
Since NO_2 has -I effect. Hence order will be

① > ② > ③.

Q Convert Benzene into

(i) p-nitro bromo benzene (ii) acetophenone

(iii) m-nitro chloro benzene (iv) p-nitrotoluene



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