

Organic Compound

Alkane, Alkene, Halogenoalkane, Nitrite compounds,
Amine, Carboxylic acid, Alcohol, Ester,
aldehyde, ketone.

Alkane

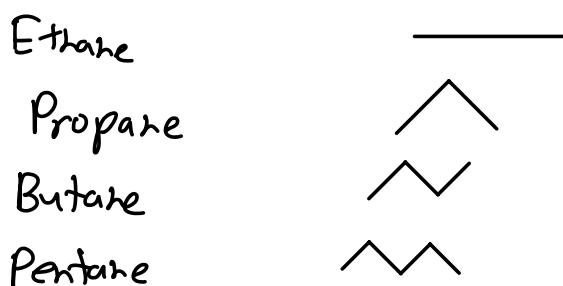
General formula



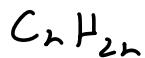
Value of n	Name of Alkane
1	Methane
2	Ethane
3	Propane
4	Butane
5	Pentane
6	Hexane
7	Heptane
8	Octane
9	Nonane
10	Decane

Molecular formula	Structural formula	Displayed formula.
CH_4	CH_4	$\begin{array}{c} \text{H} \\ \\ \text{A}-\text{C}-\text{H} \\ \\ \text{H} \end{array}$
C_2H_6	CH_3CH_3	$\begin{array}{c} \text{H} & \text{H} \\ & \\ \text{H}-\text{C} & -\text{C}-\text{H} \\ & \\ \text{H} & \text{H} \end{array}$
C_3H_8	$\text{CH}_3\text{CH}_2\text{CH}_3$	$\begin{array}{c} \text{H} & \text{H} & \text{H} \\ & & \\ \text{H}-\text{C} & -\text{C} & -\text{C}-\text{H} \\ & & \\ \text{H} & \text{H} & \text{H} \end{array}$
C_4H_{10}	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$	$\begin{array}{c} \text{H} & \text{H} & \text{H} & \text{H} \\ & & & \\ \text{H}-\text{C} & -\text{C} & -\text{C} & -\text{C}-\text{H} \\ & & & \\ \text{H} & \text{H} & \text{H} & \text{H} \end{array}$
C_5H_{12}	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$	$\begin{array}{c} \text{H} & \text{H} & \text{H} & \text{H} & \text{H} \\ & & & & \\ \text{H}-\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{C}-\text{H} \\ & & & & \\ \text{H} & \text{H} & \text{H} & \text{H} & \text{H} \end{array}$

Skeletal formula for Alkanes



Alkene
General formula



$$n = 2, 3, 4$$

Value of n	Name of alkene

- 2 ethene
 3 pro pene
 4 butene
 5 pentene

Molecular formula	Structural formula	Displayed formula
C_2H_4	$CH_2=CH_2$	$\begin{array}{c} H \quad H \\ \quad \\ C=C \\ \quad \\ H \quad H \end{array}$
C_3H_6	$CH_2=CHCH_3$	$\begin{array}{c} H \quad H \quad H \\ \quad \quad \\ C=C-C \\ \quad \quad \\ H \quad H \quad H \end{array}$
C_4H_8	$CH_2=CH-CH_2-CH_3$	$\begin{array}{c} H \quad H \quad H \quad H \\ \quad \quad \quad \\ C=C-C-C \\ \quad \quad \quad \\ H \quad H \quad H \quad H \end{array}$
C_5H_{10}	$CH_2=CH-CH_2-CH_2-CH_3$	$\begin{array}{c} H \quad H \quad H \quad H \quad H \\ \quad \quad \quad \quad \\ C=C-C-C-C \\ \quad \quad \quad \quad \\ H \quad H \quad H \quad H \quad H \end{array}$

Skeletal formula for Alkenes

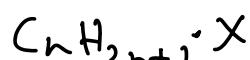
Ethere =

Propene //

Butene //\\

Pentene //\\//

Halogeno alkanes



$X \rightarrow F, Cl, Br, I$
 $n = 1, 2, 3 \dots$

Value of n	Name of Halogeno alkane	
molecular formula	Structural formula	Displayed formula
1	CH_3Cl	$H-Cl$
2	CH_3CH_2Cl	$H-C(H)-C(H)-Cl$
3	$CH_3CH_2CH_2Cl$	$H-C(H)-C(H)-C(H)-Cl$
4	$CH_3CH_2CH_2CH_2Cl$	$H-C(H)-C(H)-C(H)-C(H)-Cl$

Alcohol

General formula

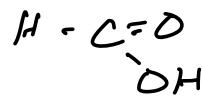


$n = 1, 2, 3, 4 \dots$

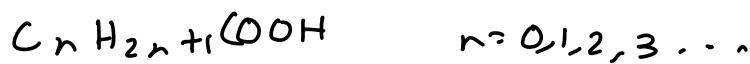
Value of n	Name of the alcohol	Molecular formula
1	Methanol	$C_2 H_6 O$
2	Ethanol	$C_3 H_8 O$
3	Propanol	$C_4 H_{10} O$
4	Butanol	$C_5 H_{12} O$

Structural formula	Displayed formula	Skeletal
$CH_3 OH$	$\begin{array}{c} H \\ \\ H-C-OH \\ \\ H \end{array}$	$—OH$
$CH_3 CH_2 OH$	$\begin{array}{c} H \\ \\ H-C-C-OH \\ \quad \\ H \quad H \end{array}$	$\diagup OH$
$CH_3 CH_2 CH_2 OH$	$\begin{array}{c} H \\ \\ H-C-C-C-OH \\ \quad \quad \\ H \quad H \quad H \end{array}$	$\diagup \diagdown OH$
$CH_3 CH_2 CH_2 CH_2 OH$	$\begin{array}{c} H \\ \\ H-C-C-C-C-OH \\ \quad \quad \\ H \quad H \quad H \end{array}$	$\diagup \diagup OH$
$CH_3 CH_2 CH_2 CH_2 OH$	$\begin{array}{c} H \\ \\ H-C-C-C-C-OH \\ \quad \quad \\ H \quad H \quad H \end{array}$	$\diagup \diagup \diagdown OH$

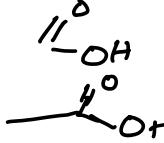
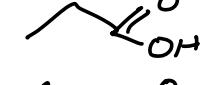
Carboxylic Acid



General formula



Value of n	Name of the alcohol	Molecular formula
1	Methanoic Acid	CH_2O_2
2	Ethanoic Acid	$\text{C}_2\text{H}_4\text{O}_2$
3	Propanoic acid	$\text{C}_3\text{H}_6\text{O}_2$
4	Butanoic acid	$\text{C}_4\text{H}_8\text{O}_2$
5	Pentanoic acid	$\text{C}_5\text{H}_{10}\text{O}_2$

Structural formula	Displayed formula	Skeletal
COOH	$\text{H}-\text{C}(=\text{O})-\text{OH}$	
CH_3COOH	$\text{H}-\overset{\text{H}}{\underset{\text{H}}{\text{C}}}-\text{C}(=\text{O})-\text{OH}$	
$\text{CH}_3\text{CH}_2\text{COOH}$	$\text{H}-\overset{\text{H}}{\underset{\text{H}}{\text{C}}}-\overset{\text{H}}{\underset{\text{H}}{\text{C}}}-\text{C}(=\text{O})-\text{OH}$	
$\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$	$\text{H}-\overset{\text{H}}{\underset{\text{H}}{\text{C}}}-\overset{\text{H}}{\underset{\text{H}}{\text{C}}}-\overset{\text{H}}{\underset{\text{H}}{\text{C}}}-\text{C}(=\text{O})-\text{OH}$	

Carbonyl Compounds : Aldehydes and Ketones

Aldehyde

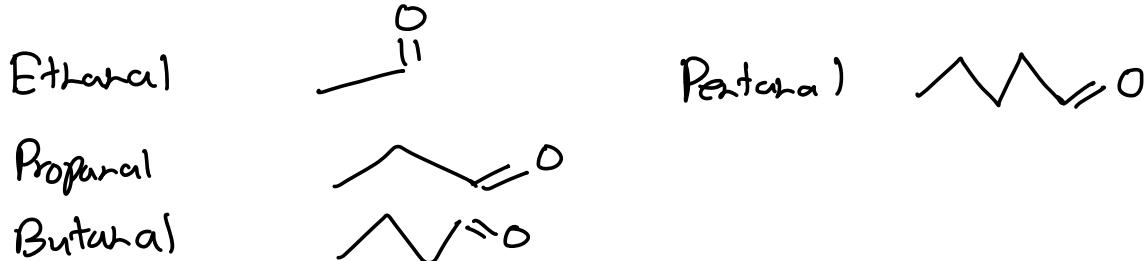
General Formula



$$n = 0, 1, 2, 3, 4, \dots$$

Value of n	Name	Molecular formula	Structural	Displayed
1	Methanal	$C_1 H_2 O$	$H-C=O$	$H-C=O$
2	Ethanal	$C_2 H_4 O$	$CH_3-C=O$	$H-C(H)-C=O$
3	Propanal	$C_3 H_6 O$	$CH_3-CH_2-C=O$	$H-C(H)-C(H)-C=O$
4	Butanal	$C_4 H_8 O$	$CH_3(CH_2)CH_2-C=O$	$H-C(H)-C(H)-C(H)-C=O$

Skeletal



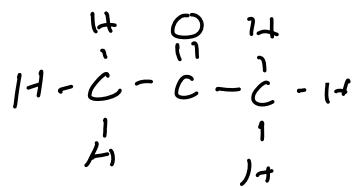
Ketone



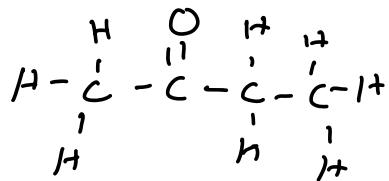
Name of
the
ketone

Displayed
formula

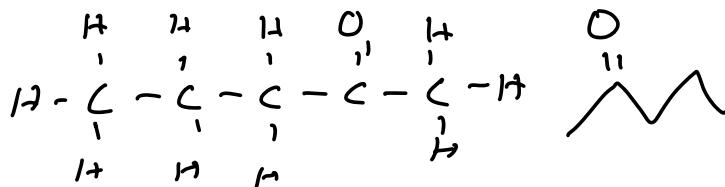
Propanone



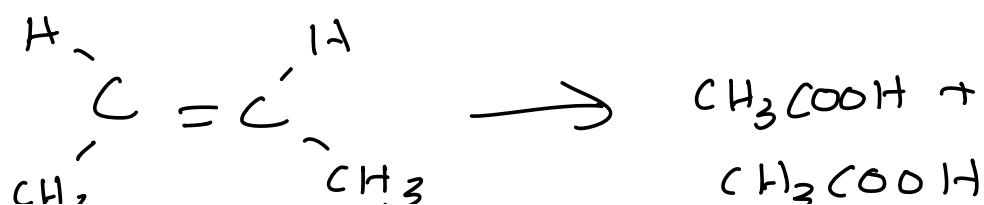
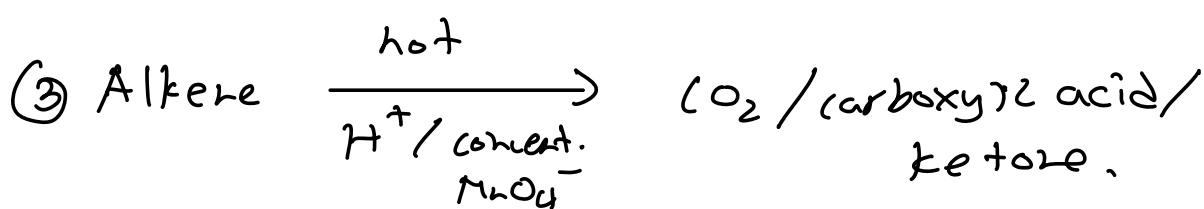
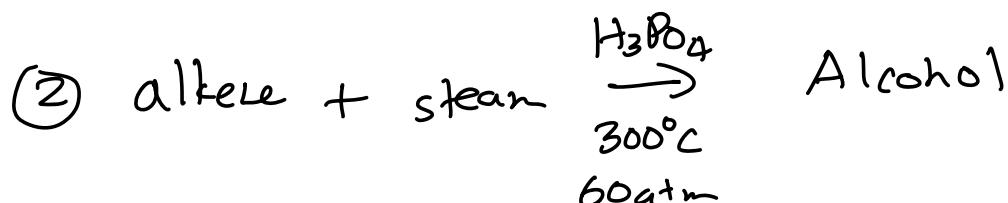
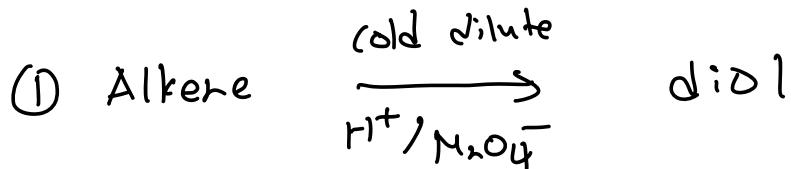
Butanone

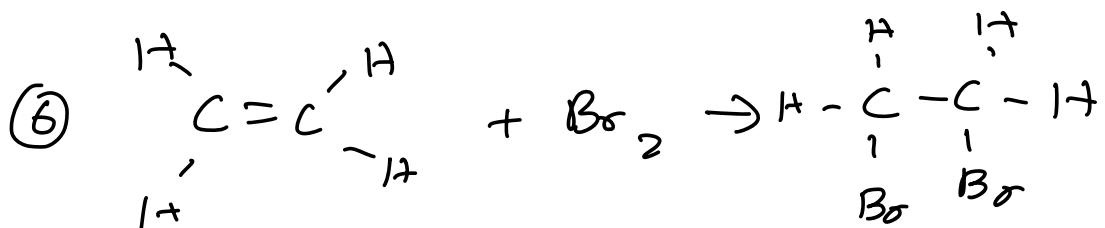
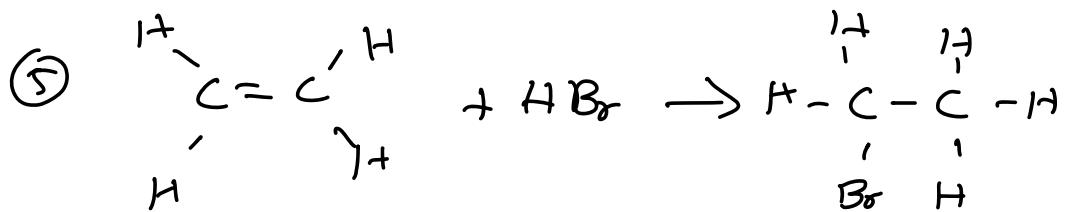
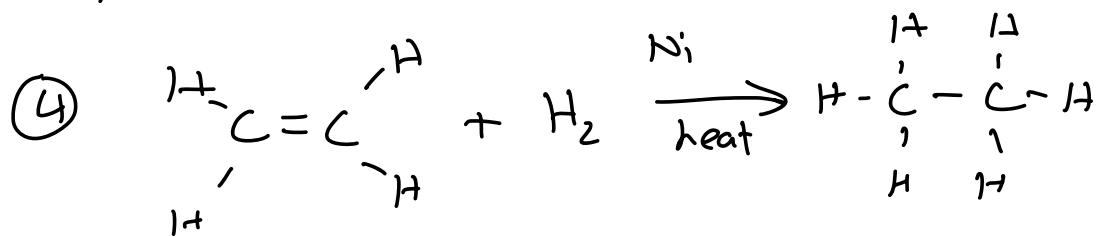
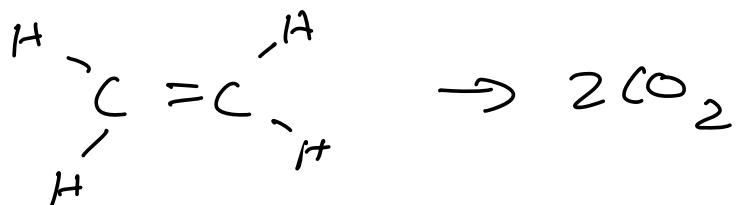
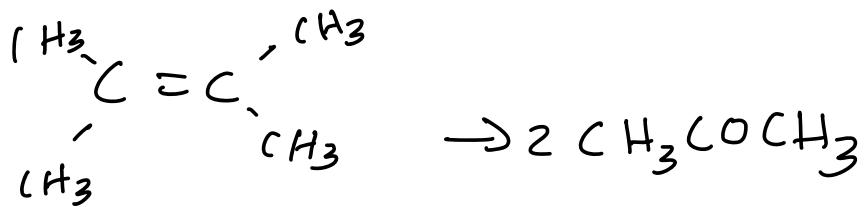


Pentanone



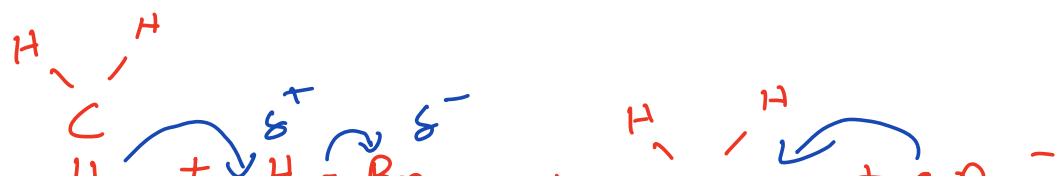
Reactions

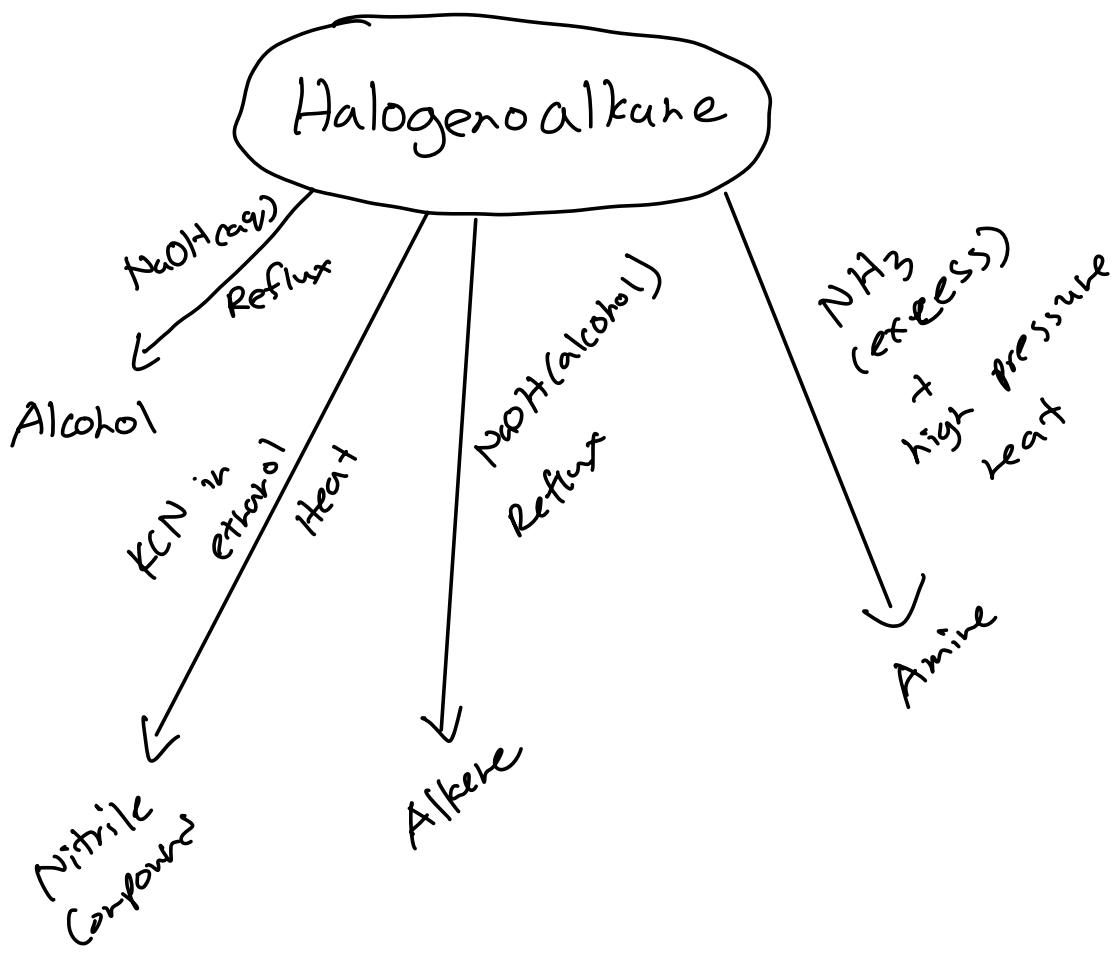
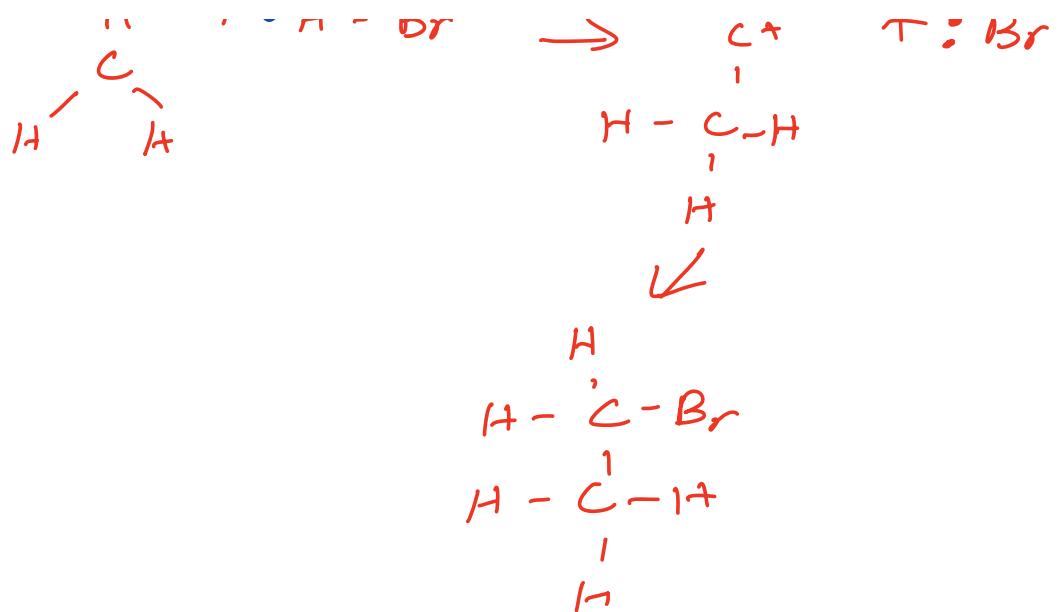




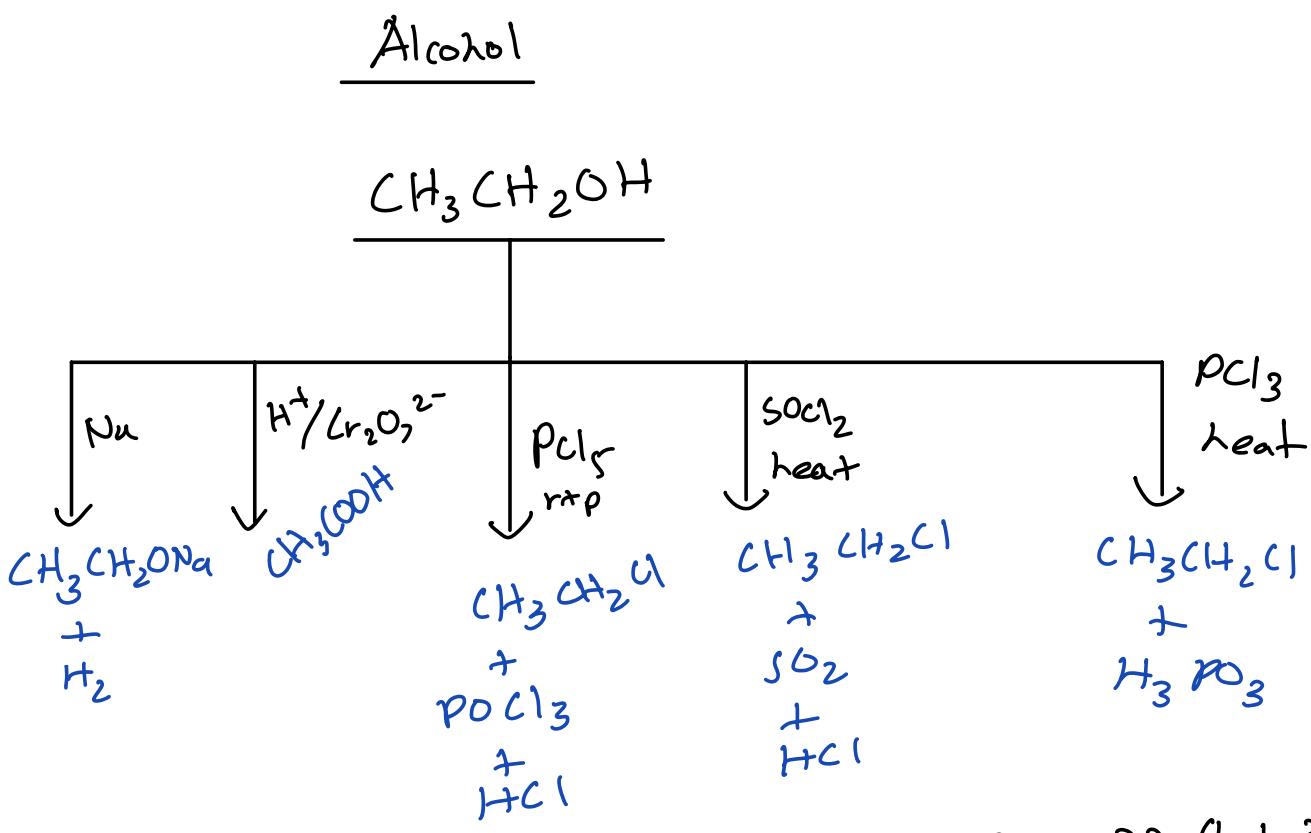
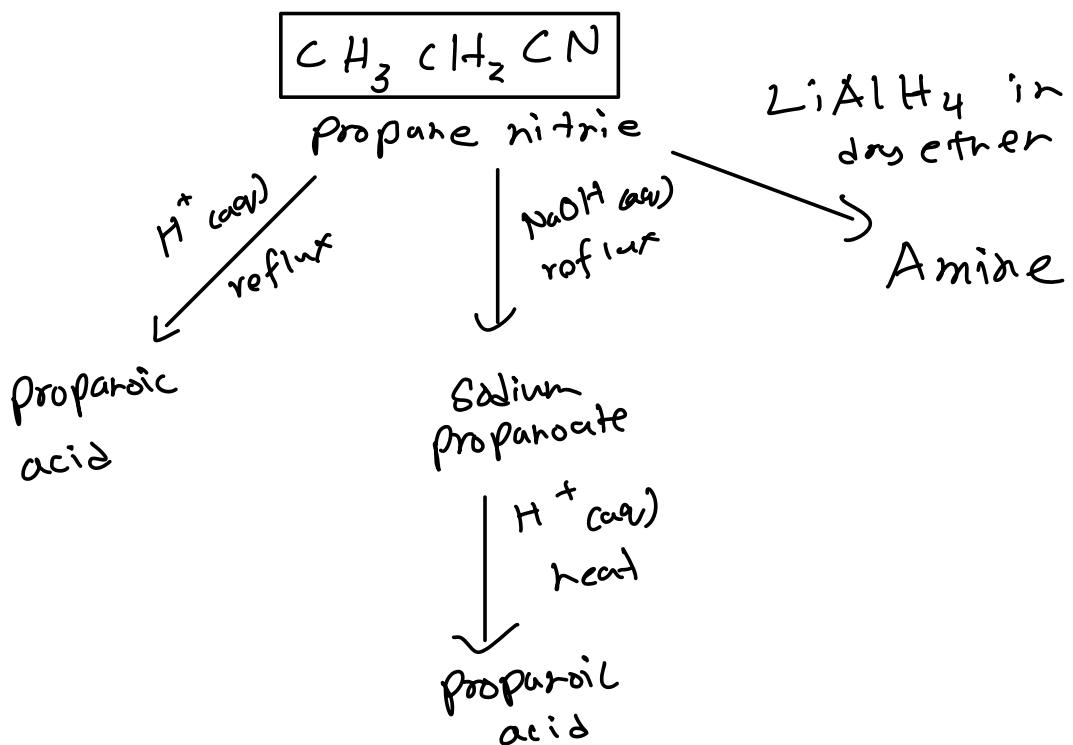
Characteristic Reactions of Akele:

Electrophilic Addition



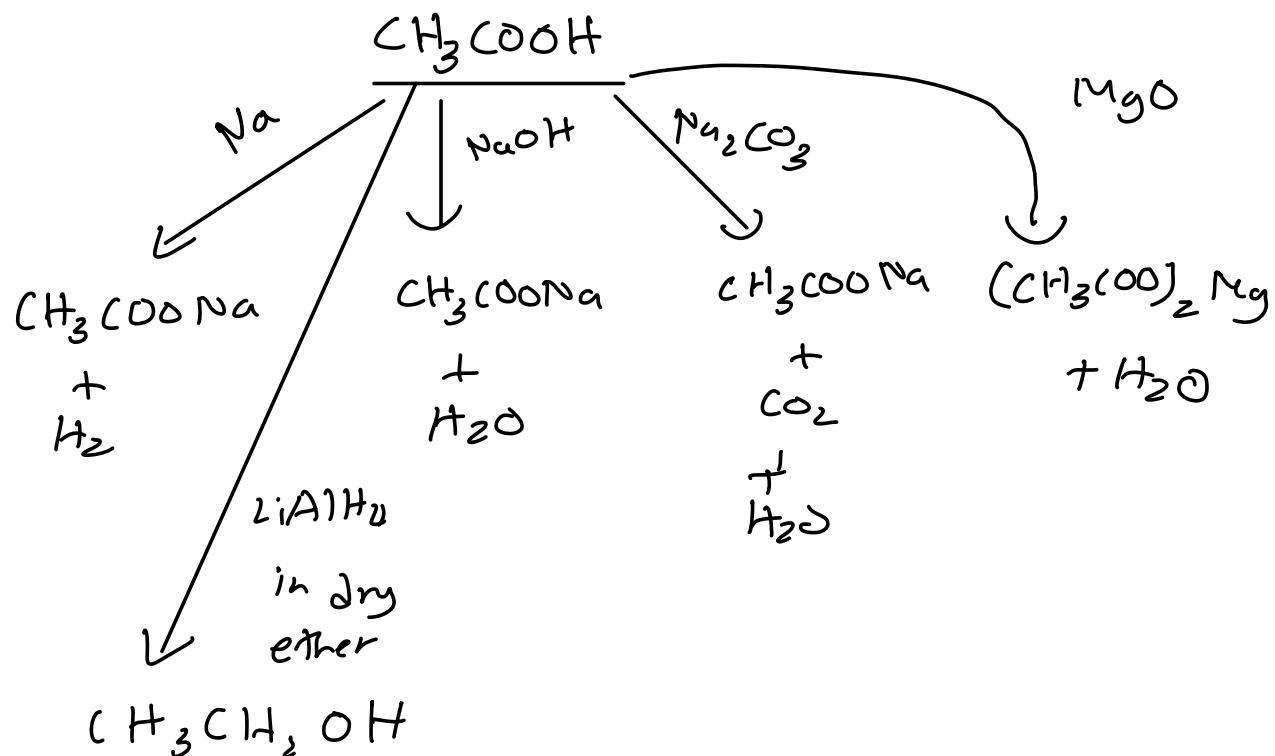


Nitrile Compounds

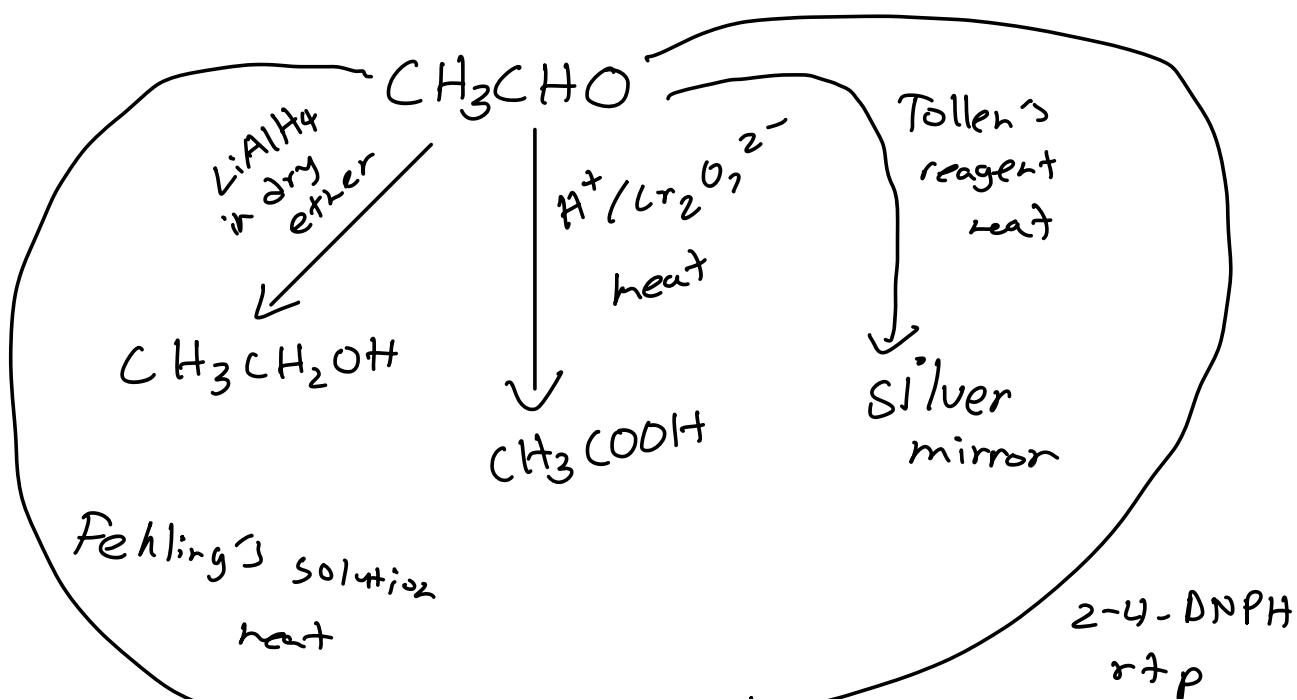


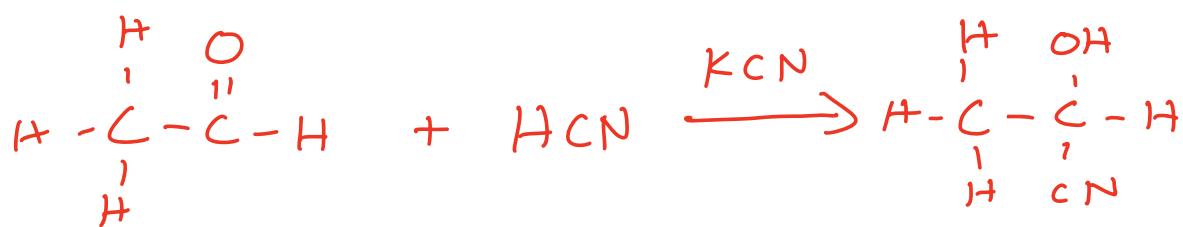
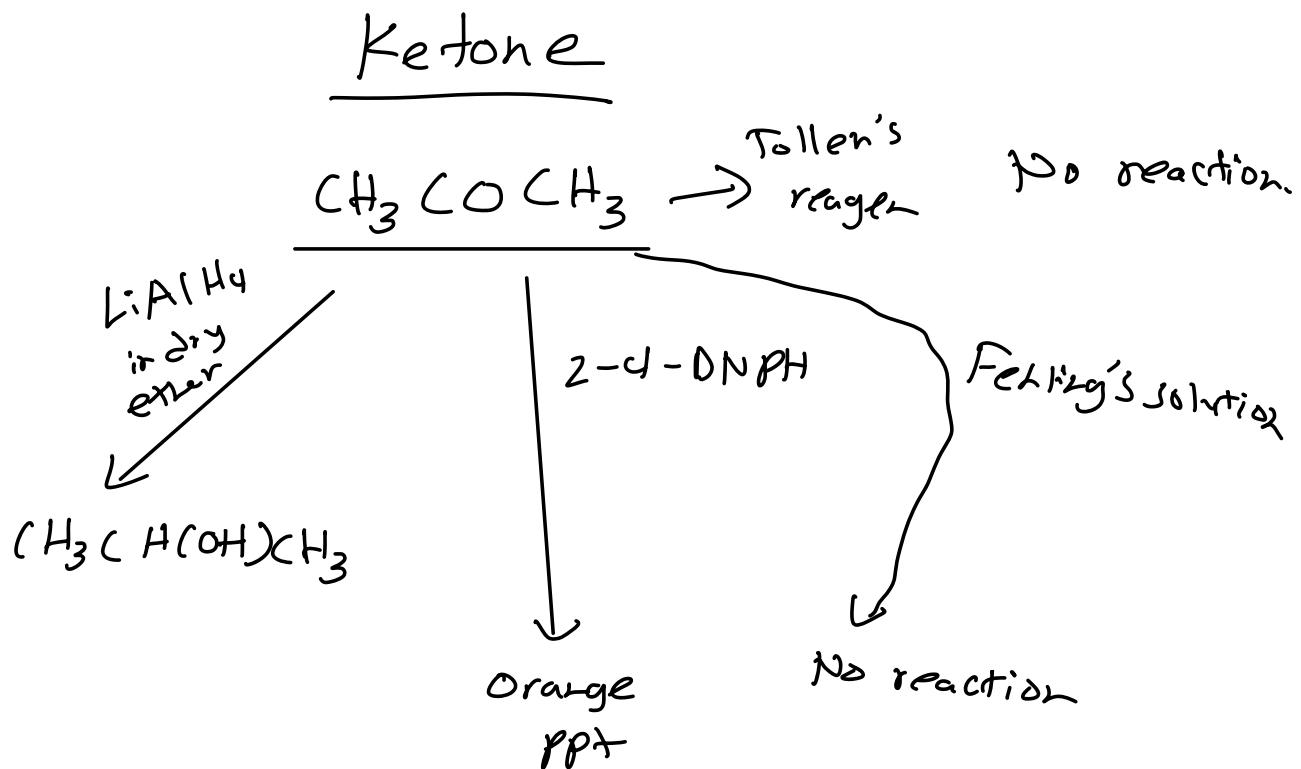
$$Sfp = 22 \cdot 4 d_2^{-3}$$

Carboxylic Acid

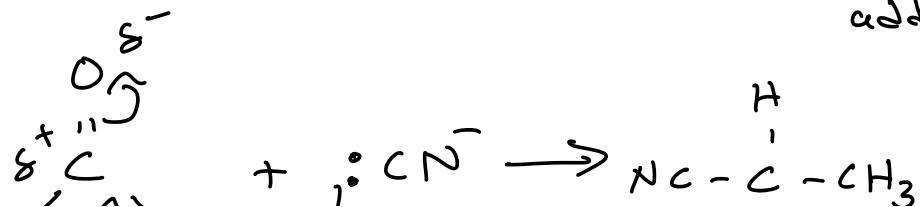


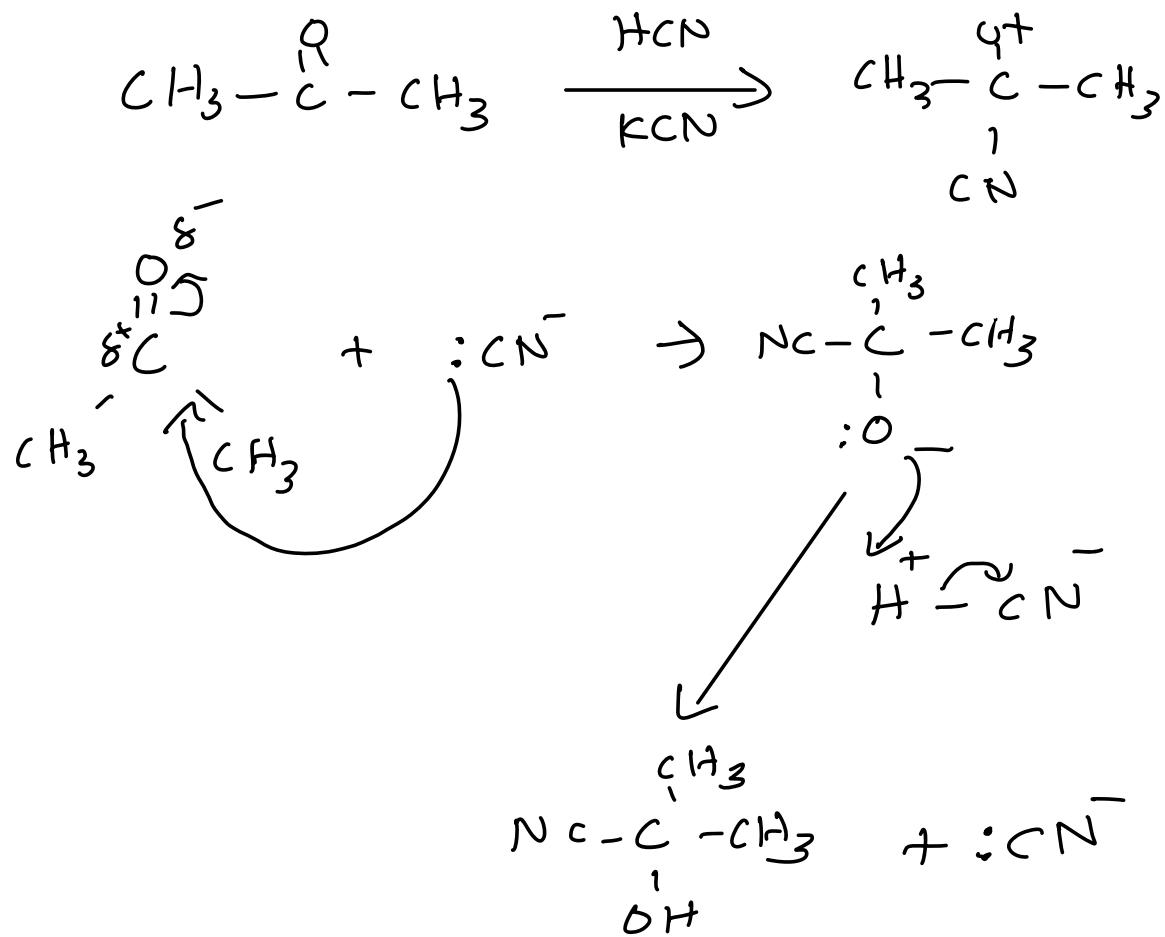
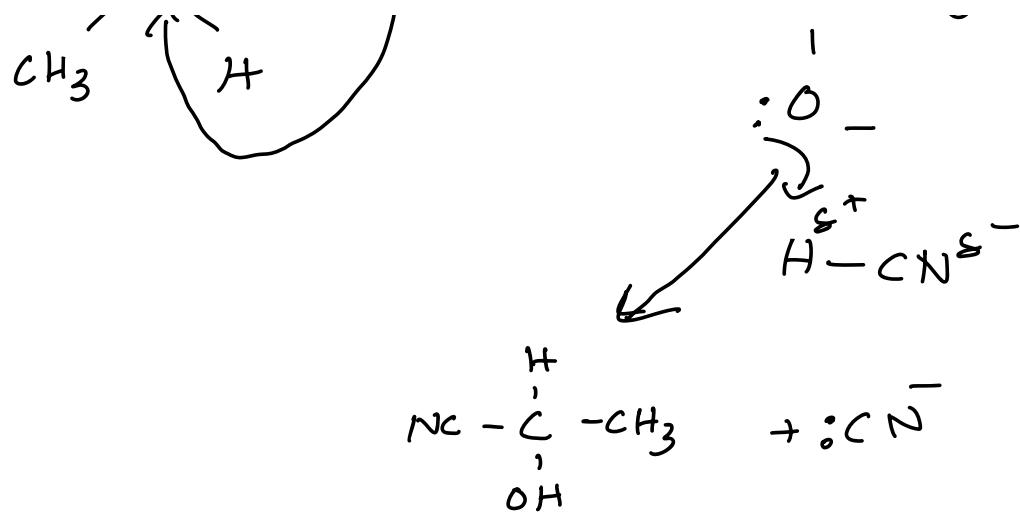
Aldehyde





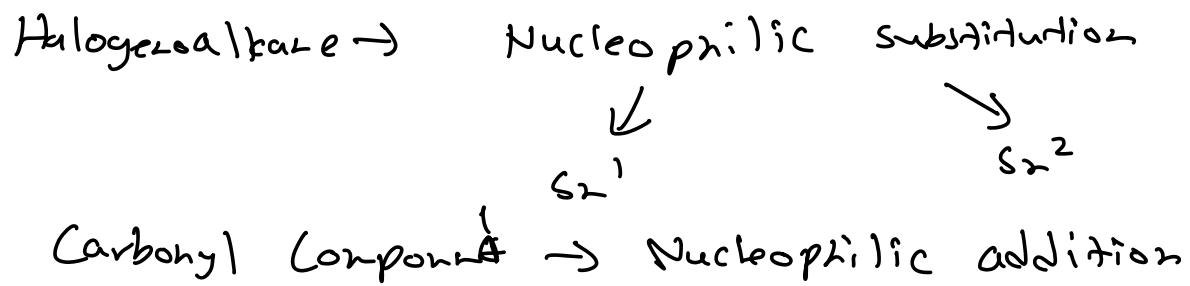
Mechanism





Alkane \rightarrow Free radical substitution

Alkene \rightarrow Electrophilic addition



Na in ethanol = reducing agent.

Organic Chemistry

Hydrocarbon

Organic compounds which have carbon and hydrogen only are called hydrocarbons.

Saturated hydrocarbons

Hydrocarbons which have carbon - carbon single bonds only are called saturated hydrocarbons.

Unsaturated hydrocarbons

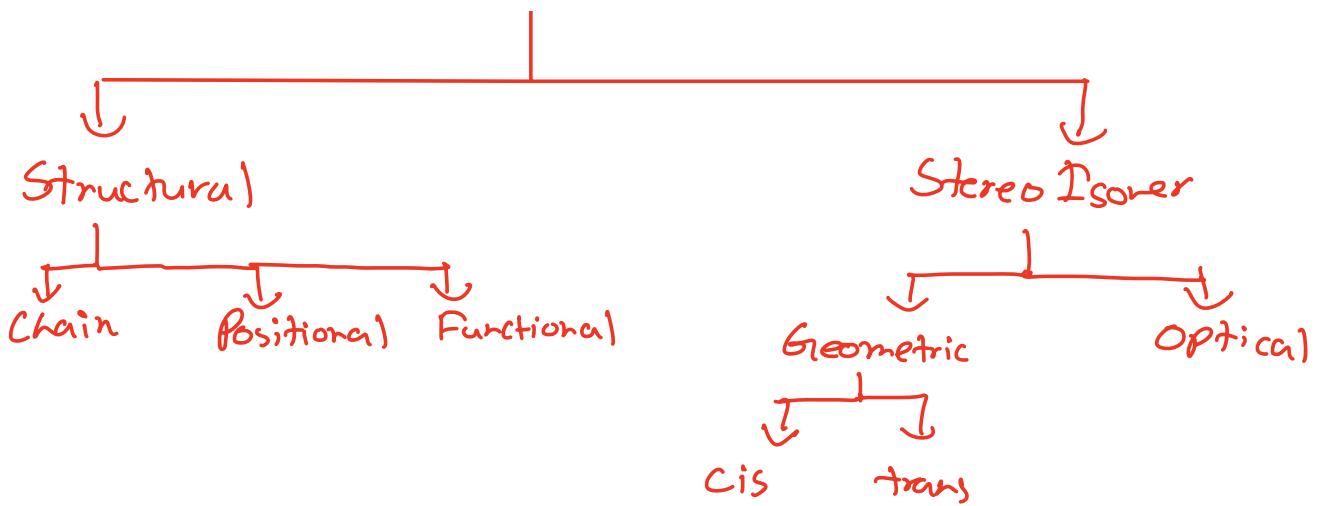
Hydrocarbons which have carbon - carbon double bond are called unsaturated hydrocarbons.

Isomer

Isomers have same molecular formula and different structural formula.

Isomer





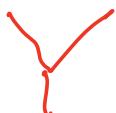
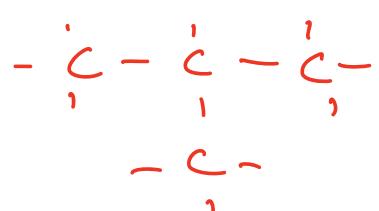
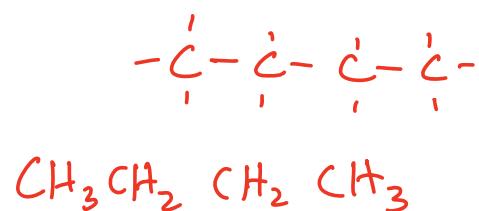
Structural Isomer

Chain isomer

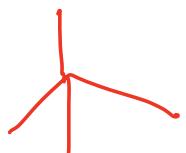
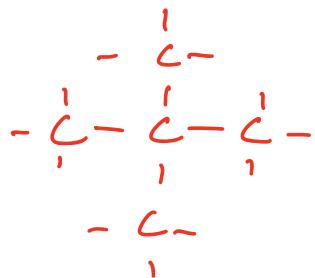
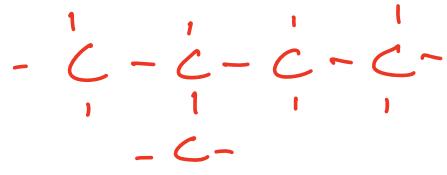
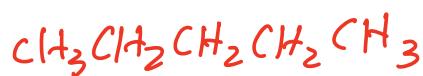
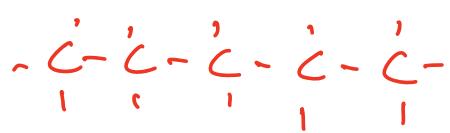
Isomers have same molecular formula but different carbon chain.

Examples

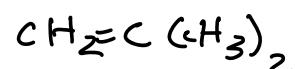
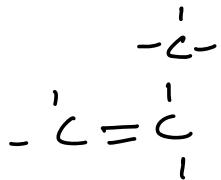
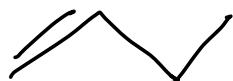
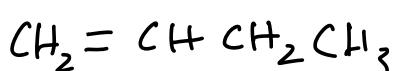
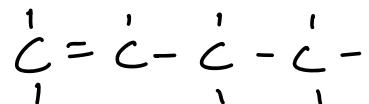
① Chain isomers of C_4H_{10}



② Chain isomers of C_5H_{12}



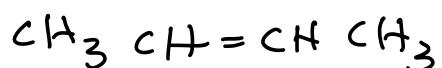
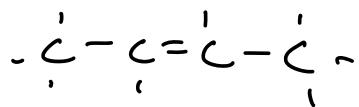
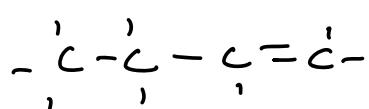
Chain isomers of C_4H_8



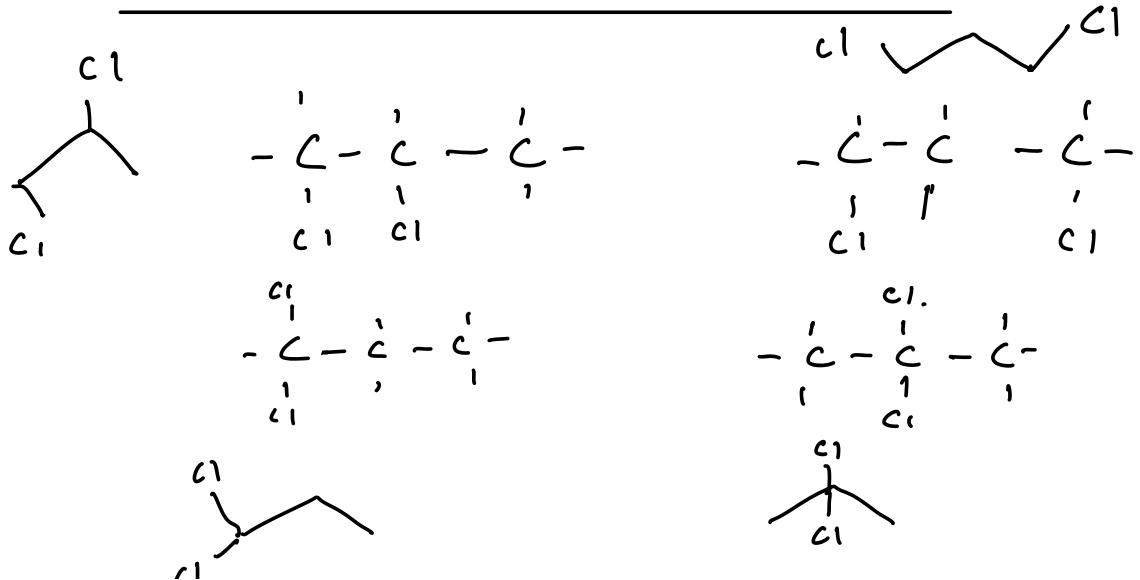
Positional isomers

Positional isomers have same molecular formula, but different position of an atom or group of atom or functional group

Positional isomers of C_4H_8



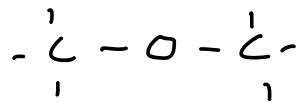
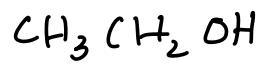
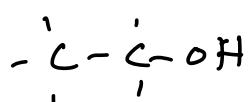
Positional isomers of $C_3H_6Cl_2$



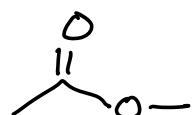
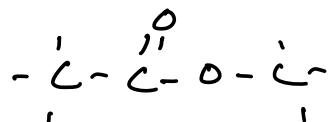
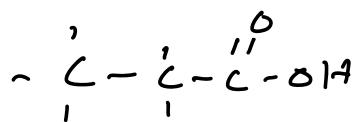
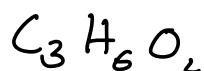
Functional Group Isomer

Isomers have same molecular formula but different functional groups.

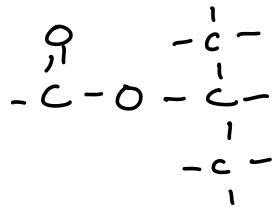
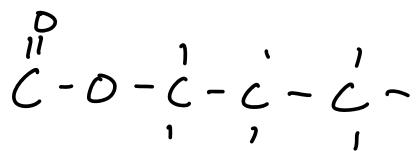
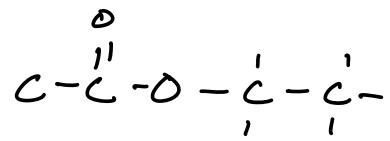
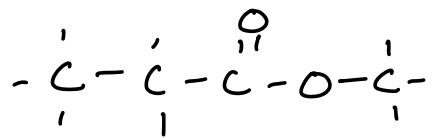
Example 1 C_2H_6O



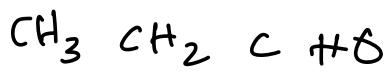
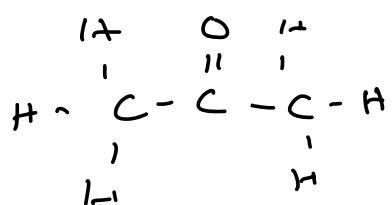
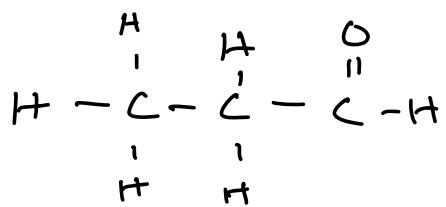
Example 2



Write the four structural isomers of C_4H_8O

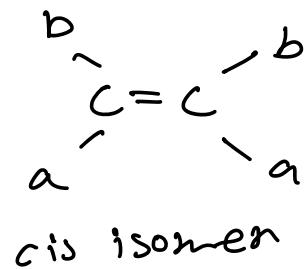
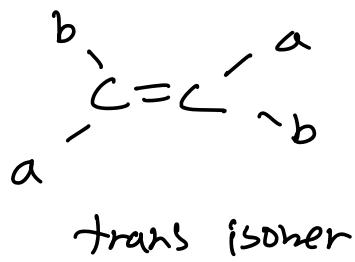


① $\text{C}_3\text{H}_6\text{O}$



Geometric Isomer

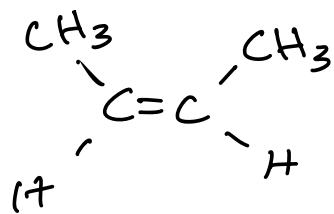
- ⊖ Carbon - carbon double bond
- ⊖ Restricted rotation about the C=C
- ⊖ Double bond containing each carbon atom has two different atoms or groups of atoms.



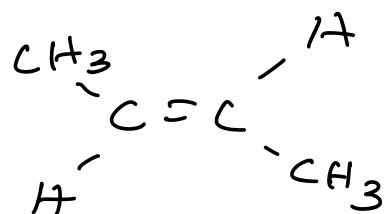
- ① Geometric isomers of C_3H_6

Not Possible

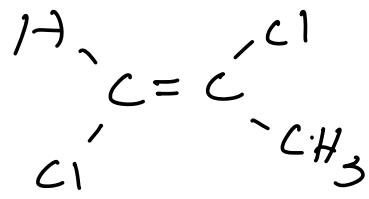
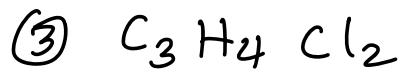
- ② Geometric isomers of C_4H_8



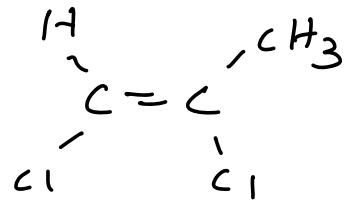
cis - but - 2 - one



trans - but - 2 - one

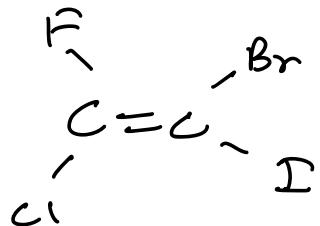


trans

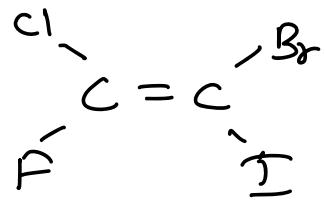


cis

④

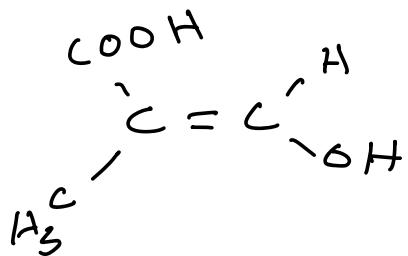


cis / Z isomer

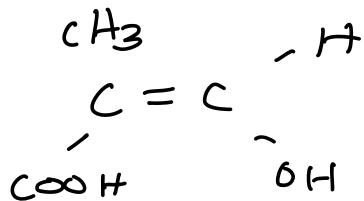


trans / E isomer

⑤

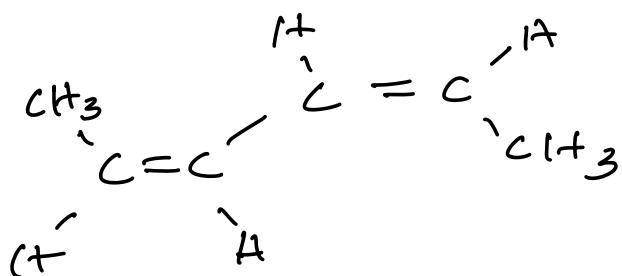


trans

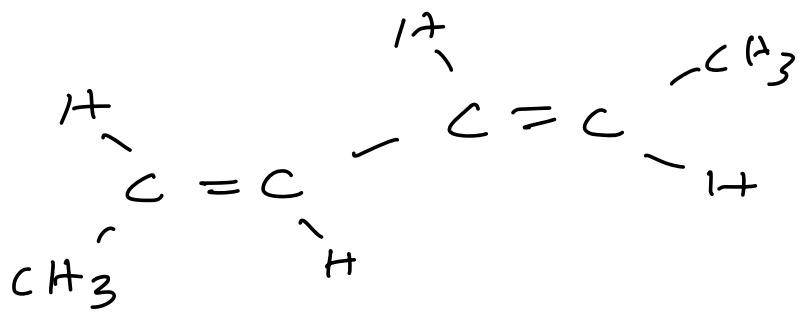


cis

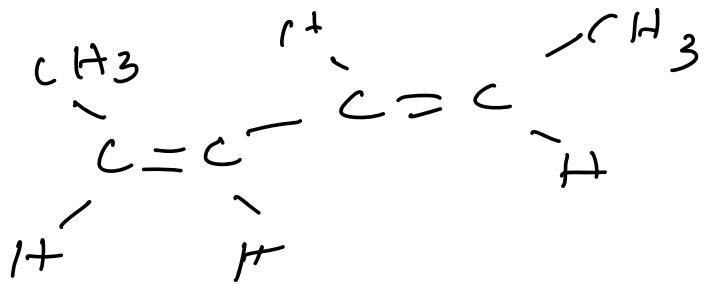
⑥



cis - cis



trans-trans



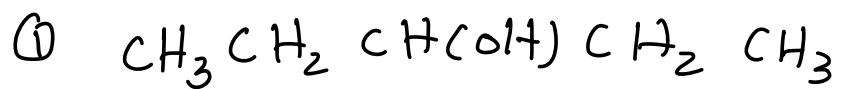
cis-trans

Optical isomers

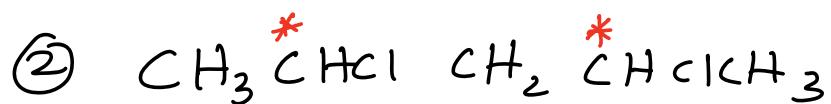
- ⑦ Organic compounds which have chiral carbon will form optical isomers.
- ⑦ Optical isomers have chiral carbon

Chiral Carbon

- ⑦ Carbon atom is joined with four different atoms or groups of atoms.



No chiral center

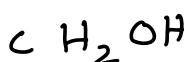
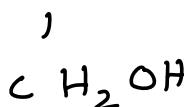
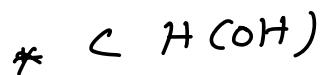
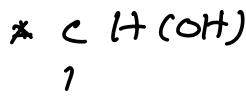
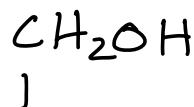


two chiral carbon

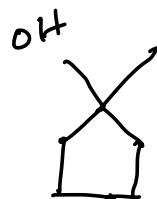


one chiral center.

④

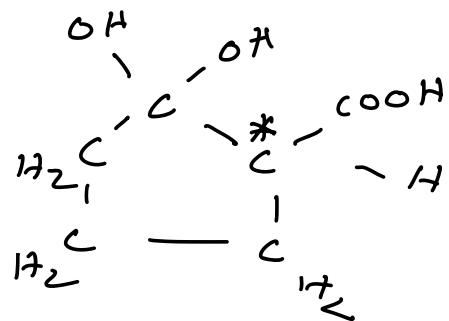


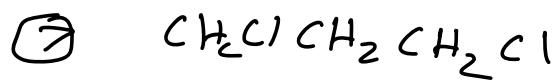
⑤



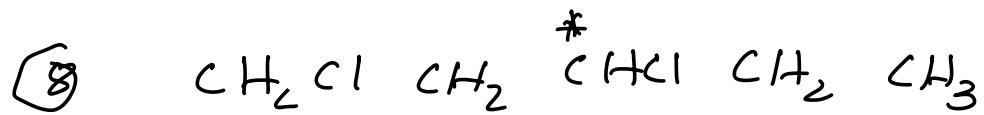
No chiral carbon

⑥



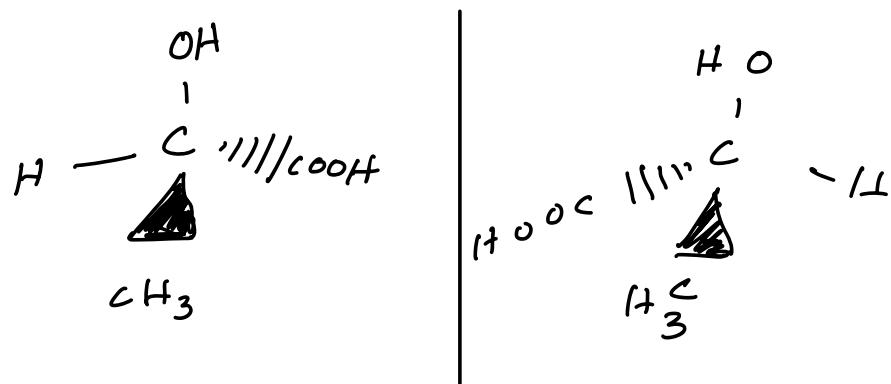


No chiral carbon



(one chiral carbon)

Optical isomers of $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$



Characteristics reactions of the organic compounds

Homologous Series	Characteristic reaction / mechanism
Alkane	Free radical substitution
Alkene	Electrophilic addition
Haloalkane	Nucleophilic substitution
(Carbonyl) compound	Nucleophilic addition
Benzene	Electrophilic substitution

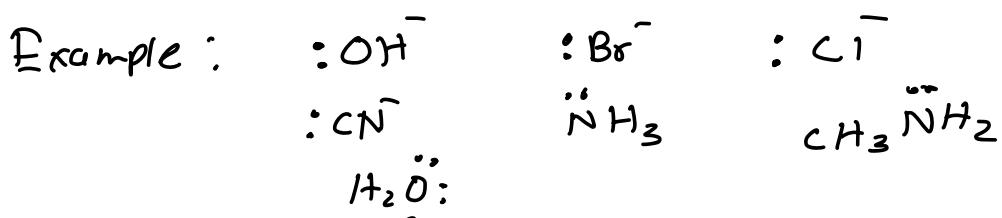
Electrophile

- ① Electrophiles are electron pair acceptor
- ② Electrophiles are positively charged or neutral molecules. (electron deficient compounds)

Examples : H^+ , CH_3^+ , $+\overset{\text{O}}{\underset{\text{||}}{\text{C}}}-\text{CH}_3$, AlCl_3

Nucleophile

- ⊖ Nucleophiles are electron pair donors.
- ⊖ Nucleophiles are negatively charged ions or neutral.



Homolytic fission

- ⊖ During the homolytic fission, bond pair electrons are equally distributed between two bonded atoms.
- ⊖ Due to the homolytic fission, free radicals are formed.
- ⊖ Free radicals have unpaired electrons.
- ⊖ Free radicals are highly reactive.
- ⊖ Homolytic fission is endo thermic

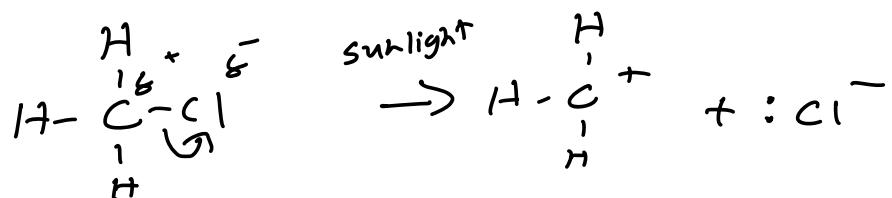
Example



Heterolytic fission

- ⊖ During the heterolytic fission, bond pair electrons are unequally distributed between two bonded atoms.
- ⊖ Due to the heterolytic fission electrophile and nucleophiles are formed.

Example



Reactions of Alkanes

① Free radical substitution



Reaction mechanism

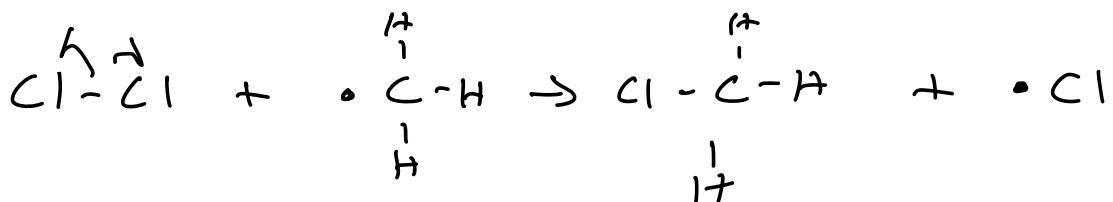
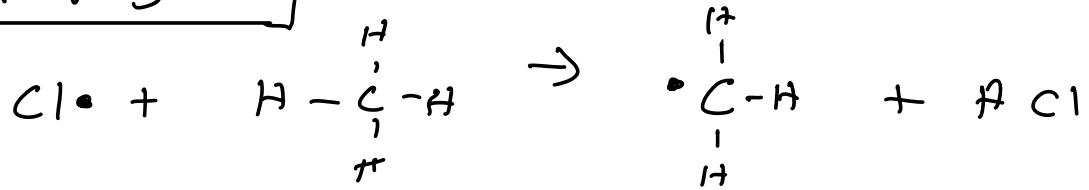
Initiation

① Free radicals are formed due to the homolytic fission.

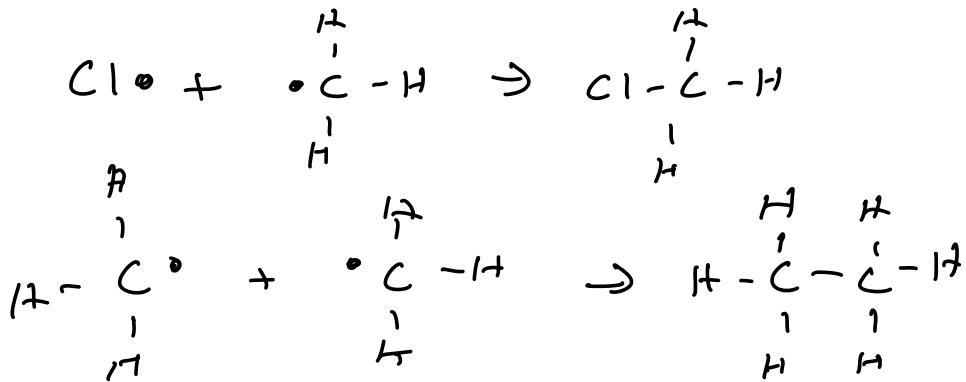
② Sunlight is needed.



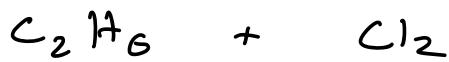
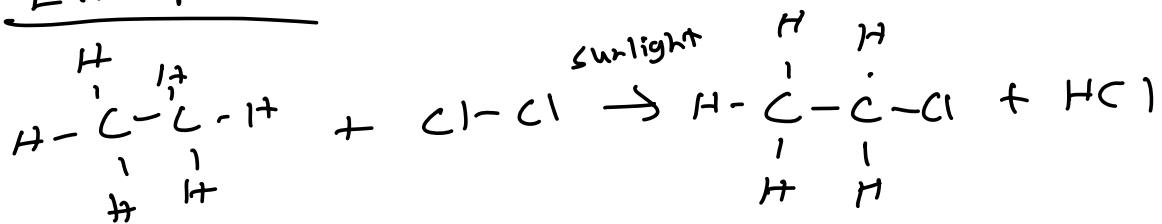
Propagation



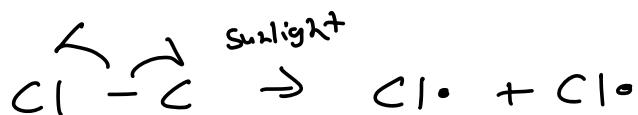
Termination



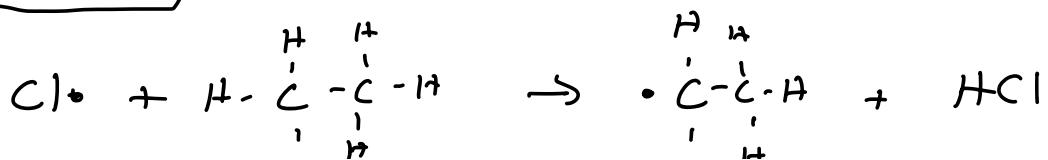
Example-2

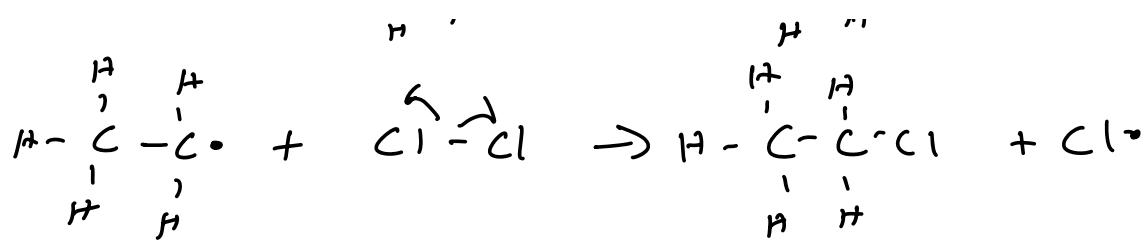


Initiation

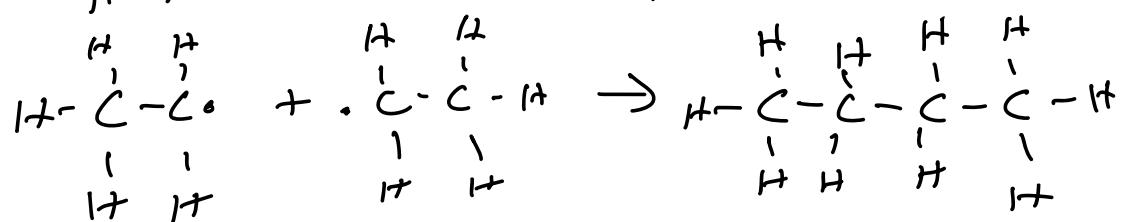
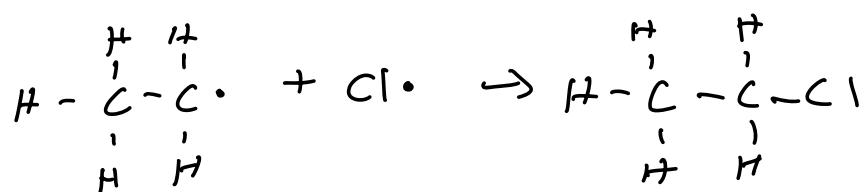


Propagation



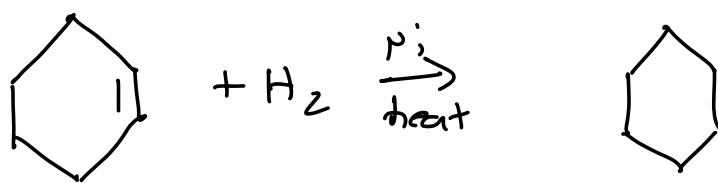
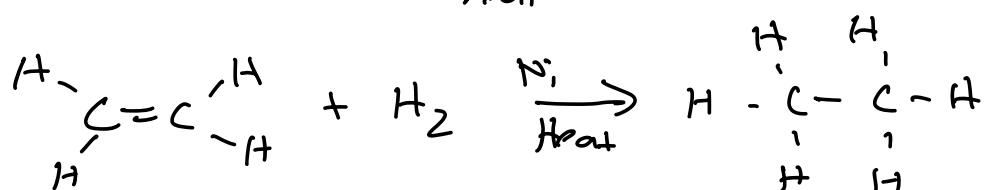
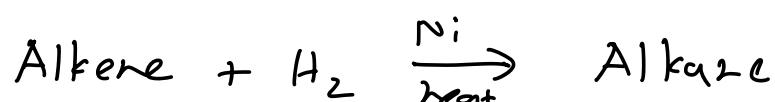


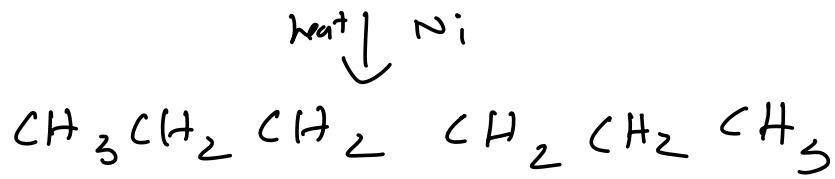
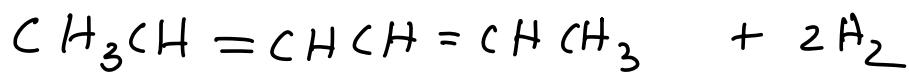
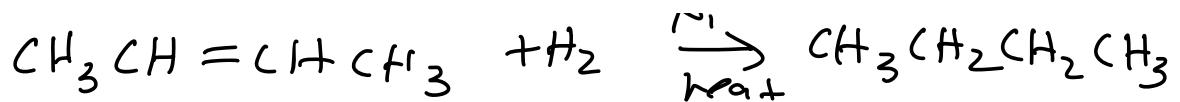
Termination



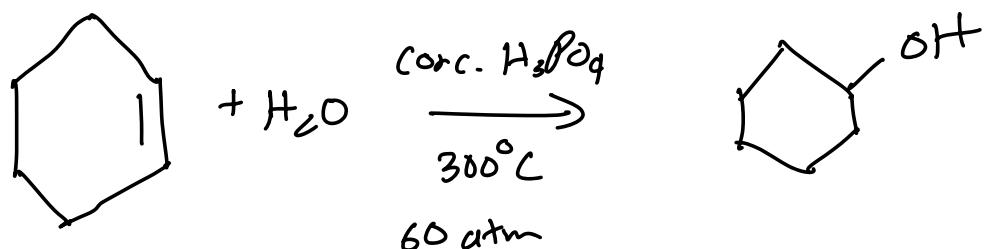
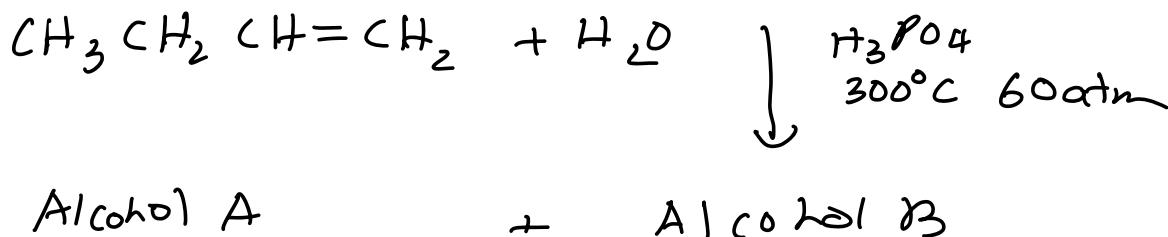
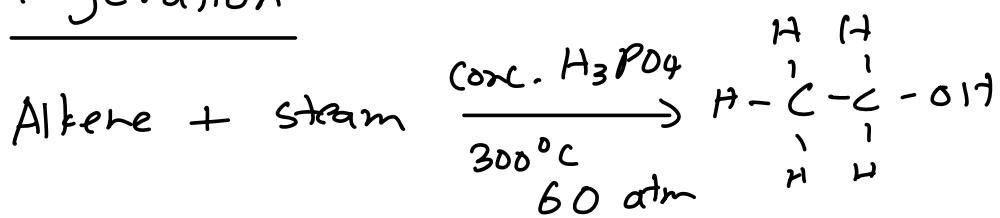
Reactions of Alkenes

① Hydrogenation *also aldehyde and ketone*



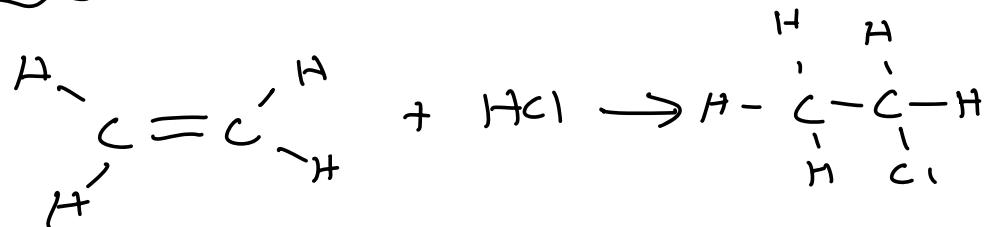


② Hydration

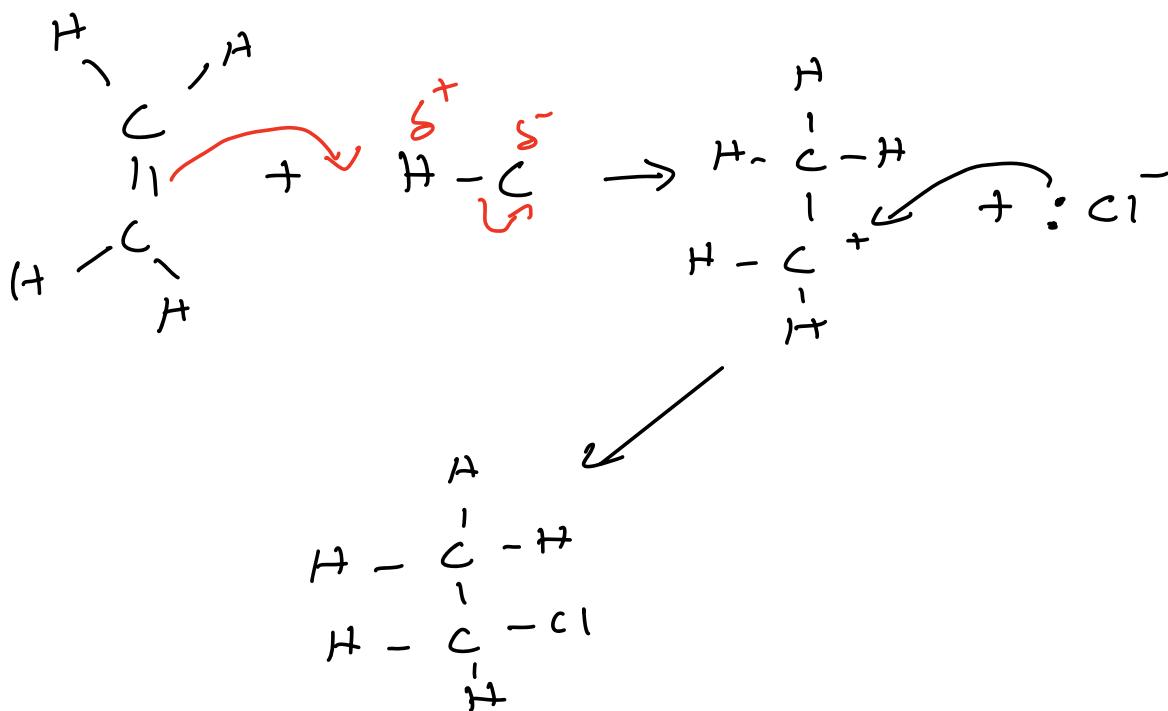


Reaction of Alkene with Hydrogen Halides

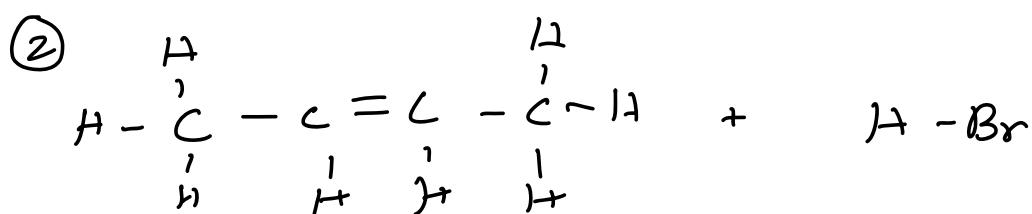
Reaction

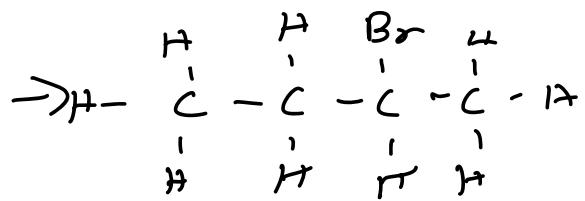


Mechanism

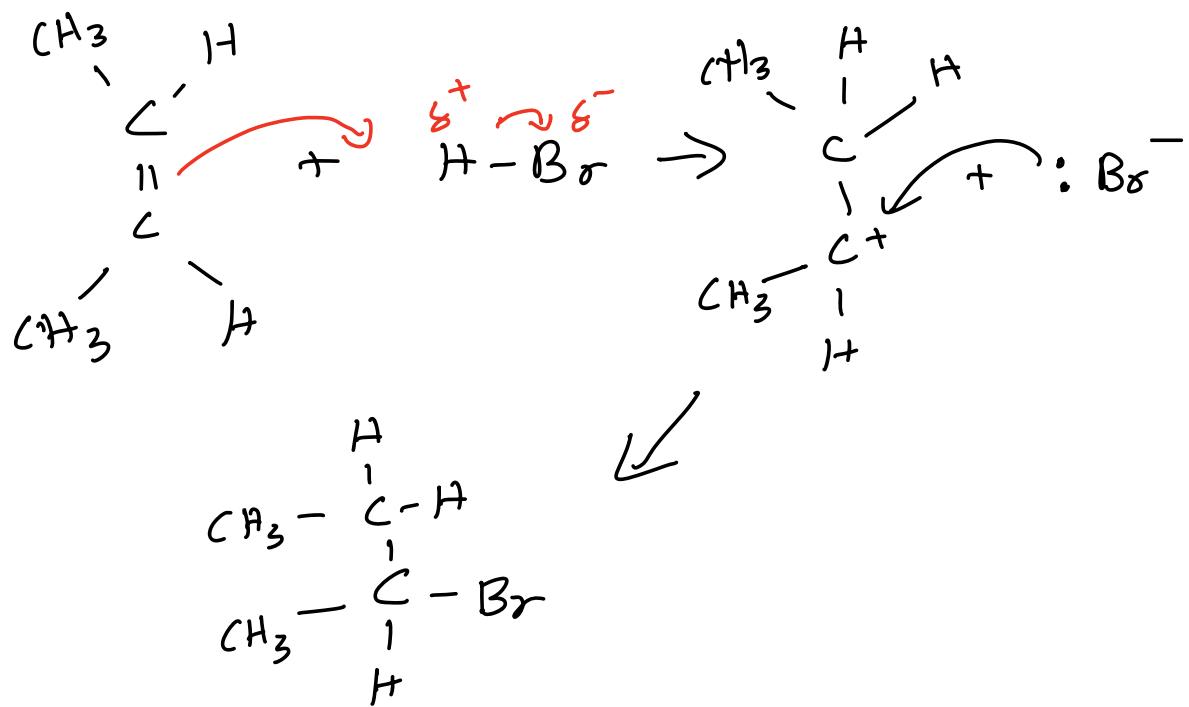


Reaction

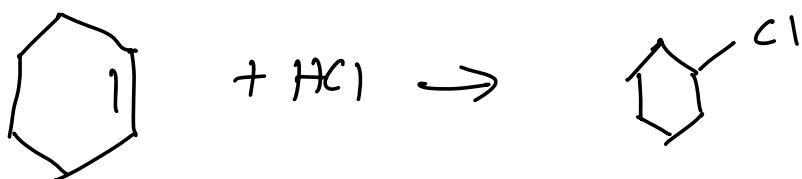




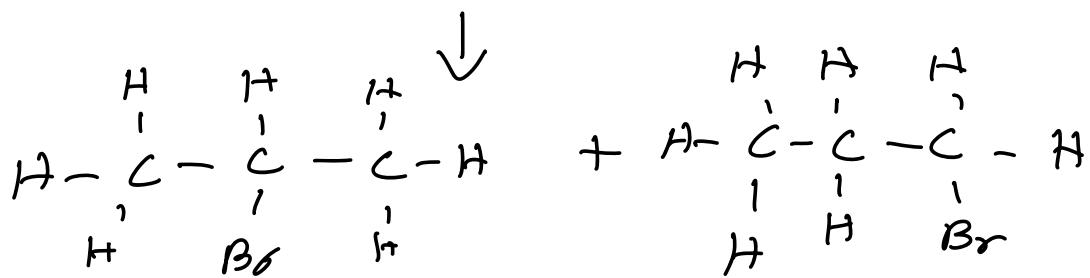
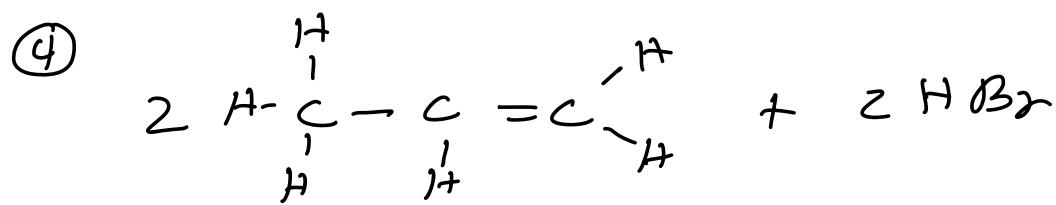
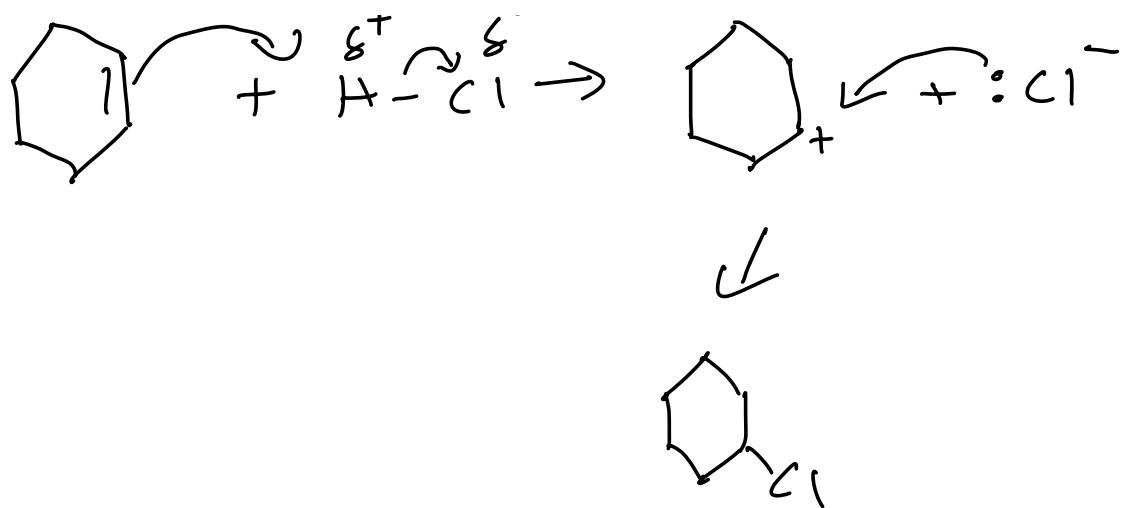
Mechanism



(3)



Mechanism



2-bromo-2-butene

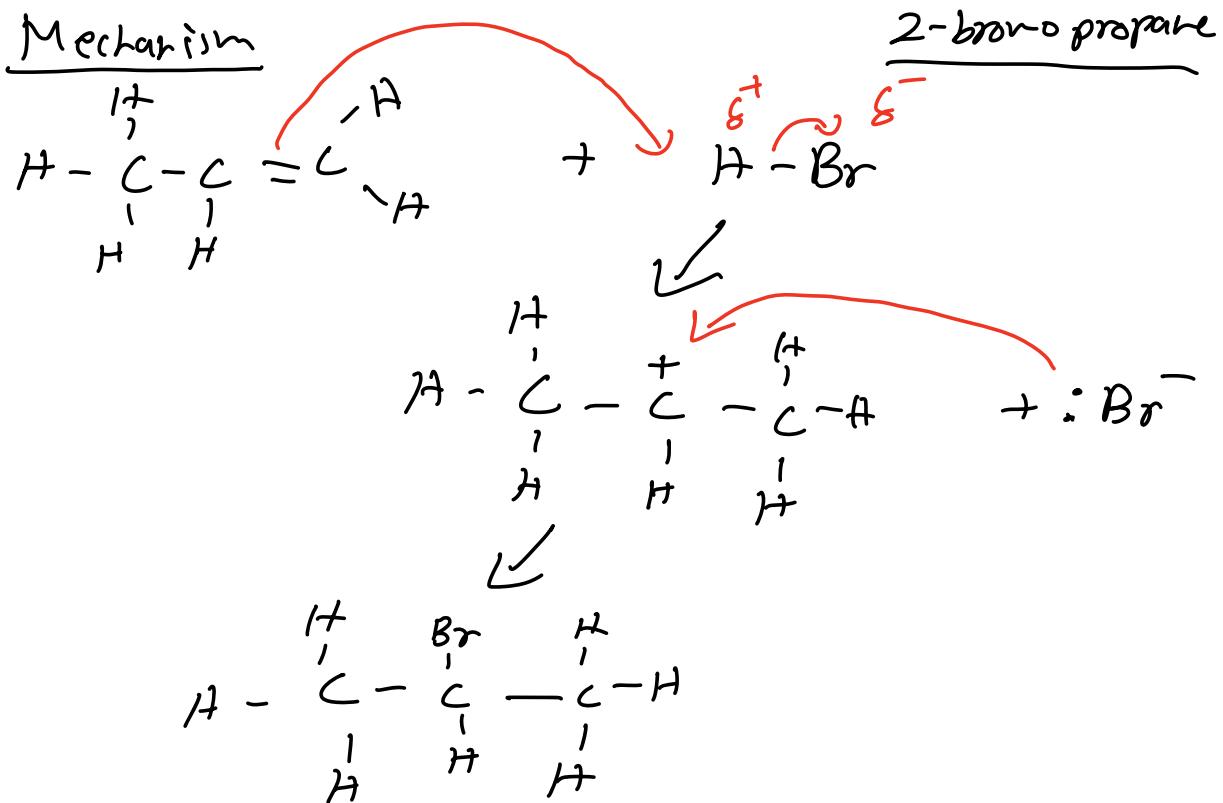
Max

Major

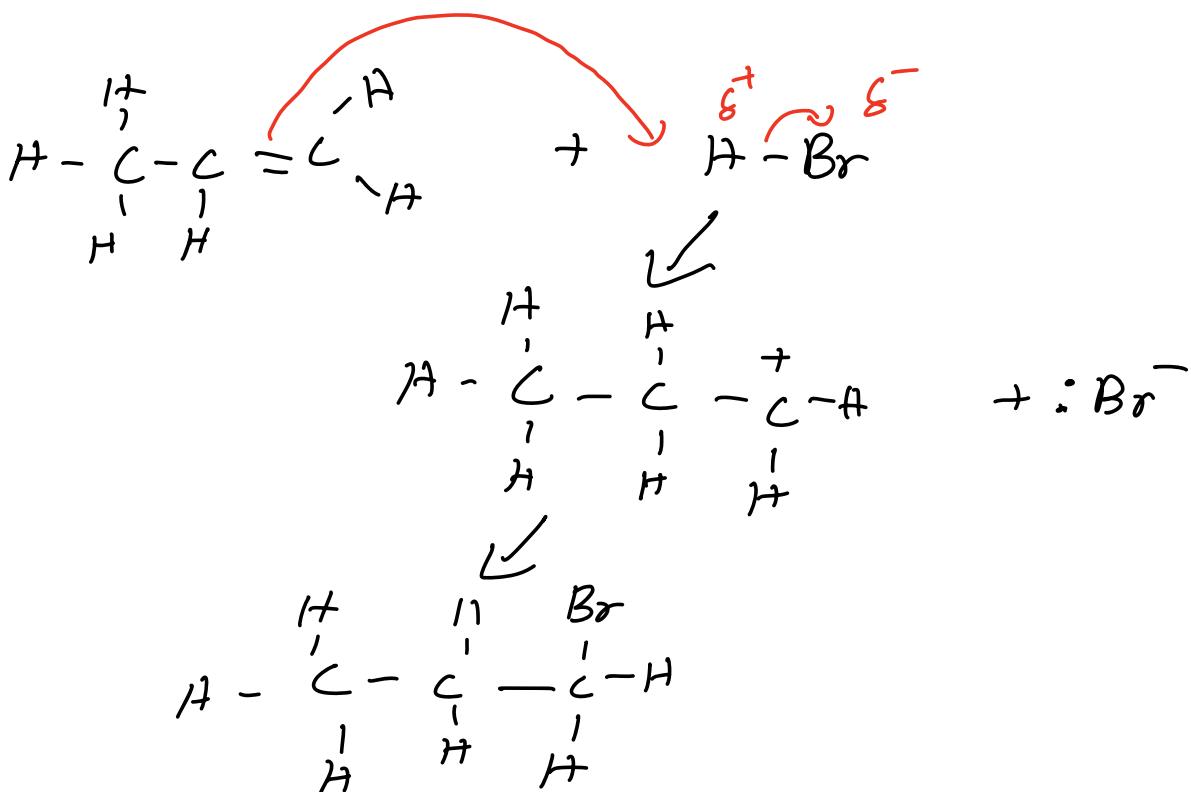
1-bromo-1-butene

Min

Minor



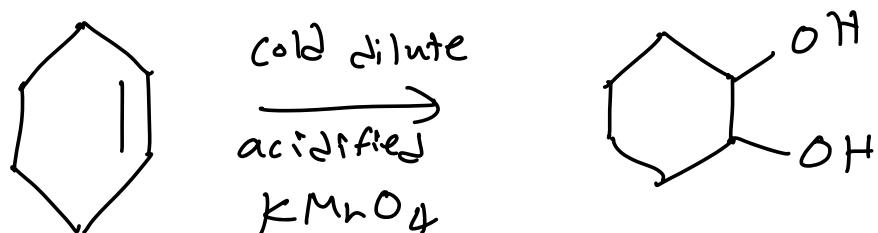
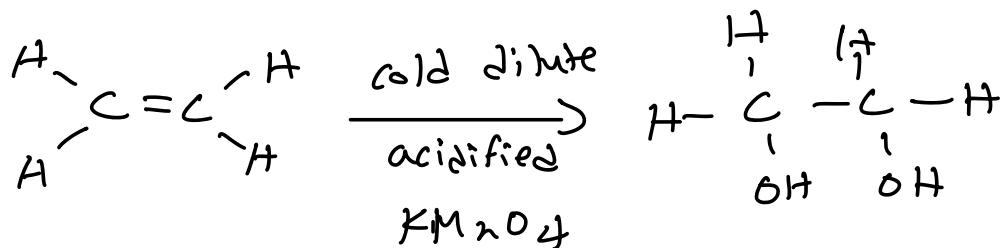
1 - bromo propanethiol .



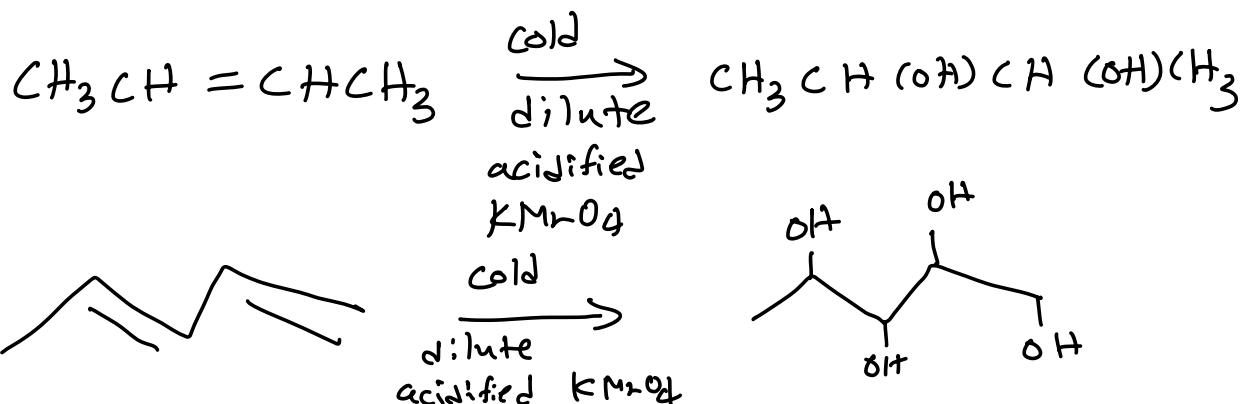
Reaction of Alkene with cold dilute acidified $KMnO_4$

Alkenes react with cold dilute acidified $KMnO_4$ to make diol.

Examples

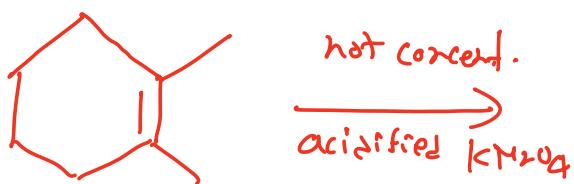
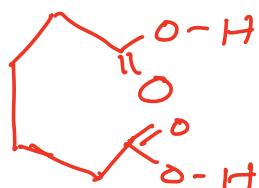
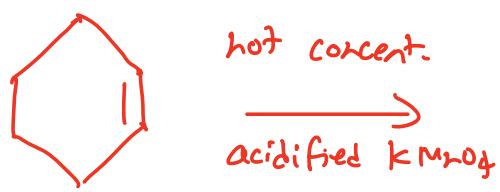
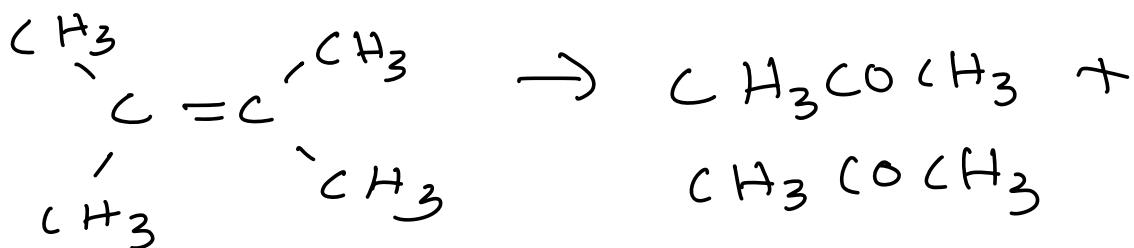
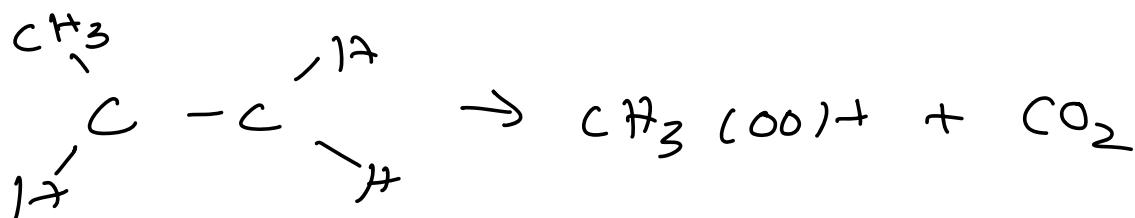
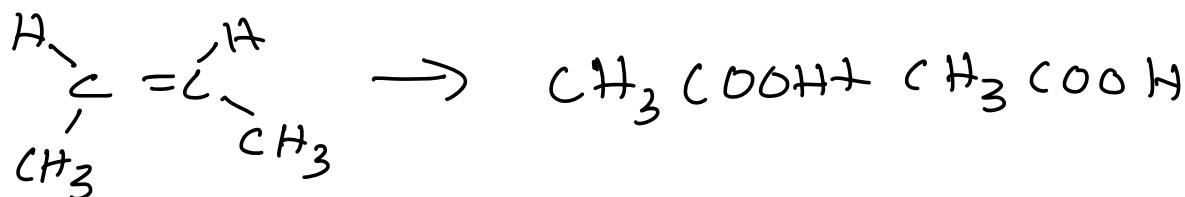
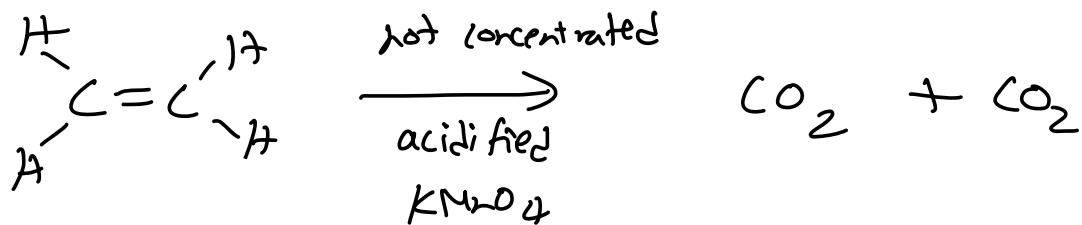


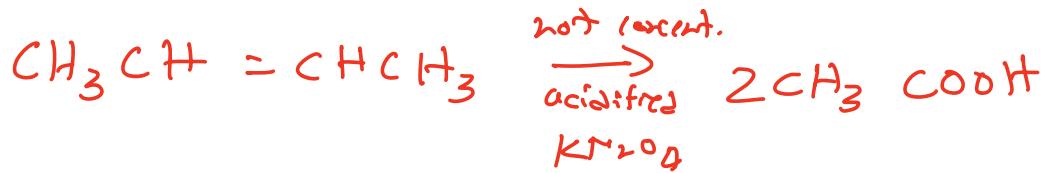
* Potassium dichromate does not react with alkene.



*

Reaction of Alkene with hot concentrated acidified $KMnO_4$



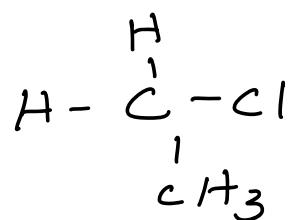


Halogenoalkane

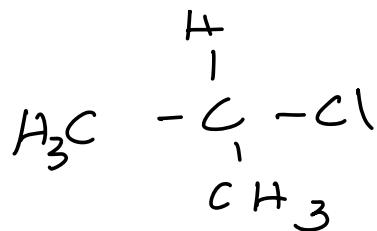
Characteristics reaction of the Halogenoalkane is nucleophilic substitution.

Types of Halogeno alkane

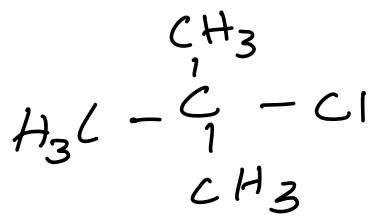
Primary halogenoalkane



Secondary halogeno alkane



Tertiary halogenoalkane



Nucleophilic substitution

Sn^1

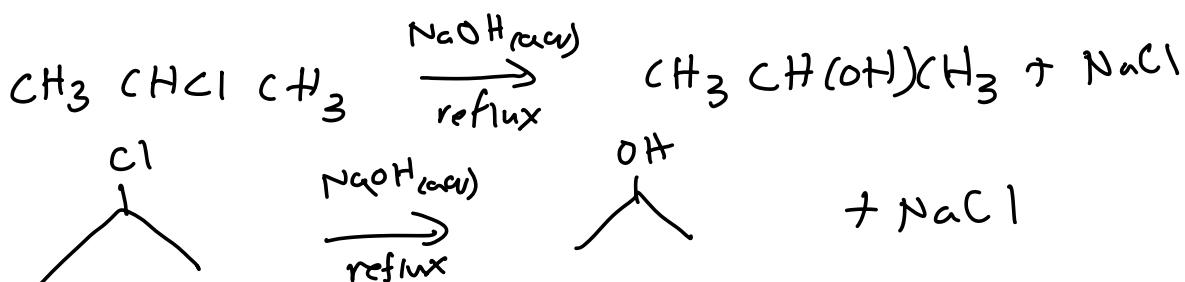
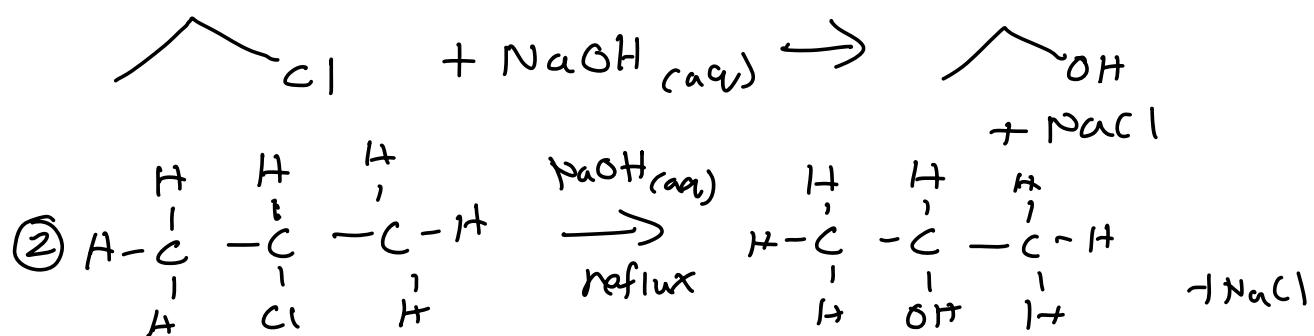
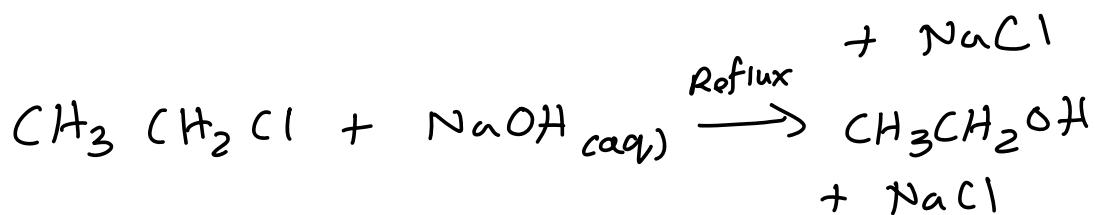
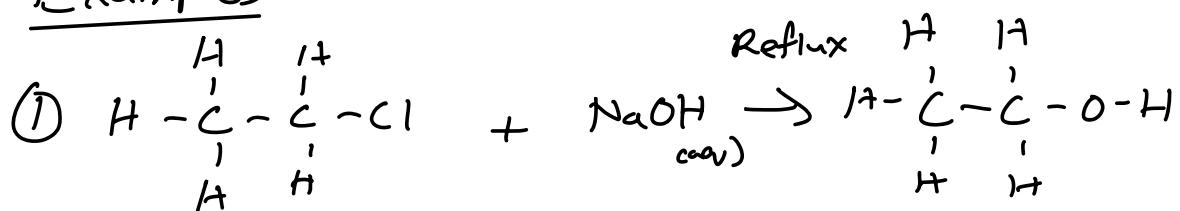
Sn^2

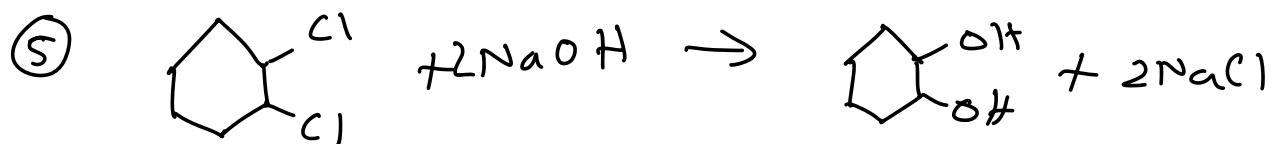
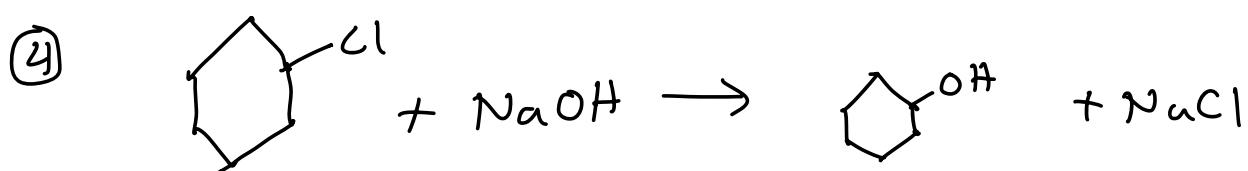
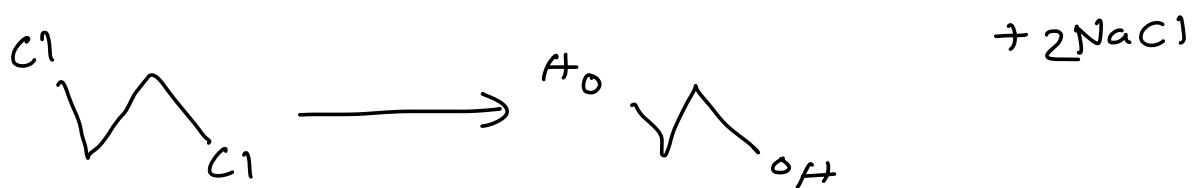
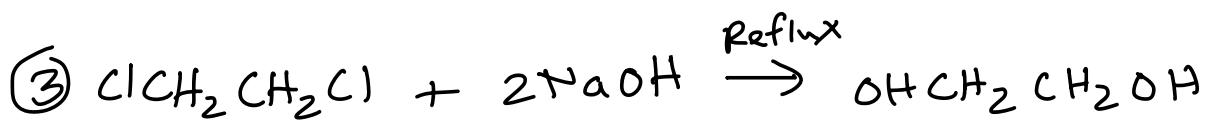
- ⊖ primary halogenoalkanes represents Sn^2 .
- ⊖ Tertiary halogenoalkanes represent Sn^1
- ⊖ Secondary halogenoalkanes represent Sn^1 and Sn^2

Preparation of Alcohol from halogenoalkane

- ① Halogenoalkanes react with aqueous sodium hydroxide to make alcohol.
- ② Heat under reflux / reflux is needed.

Examples

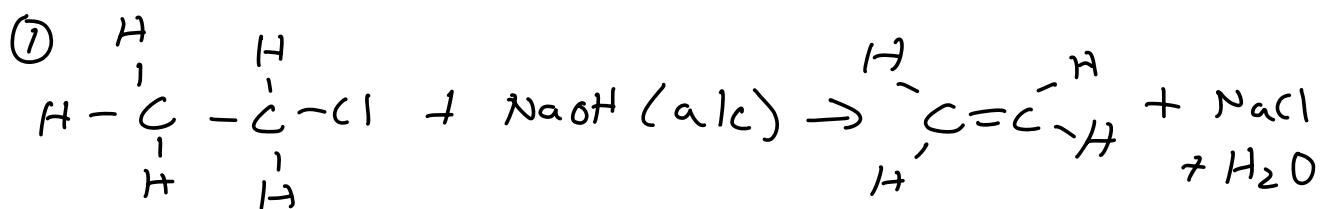


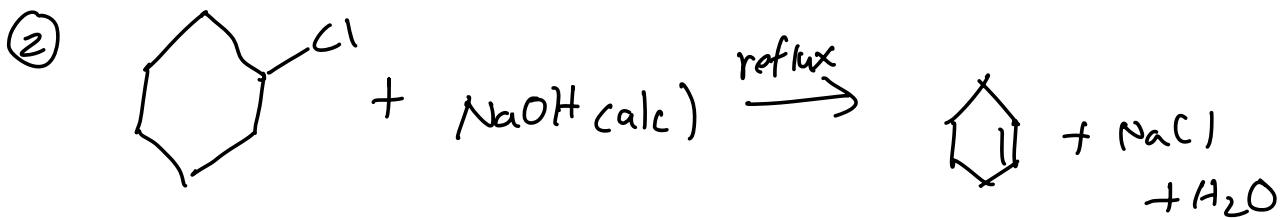


Preparation of alkene from halogenoalkane

Halogenoalkanes react with alcoholic sodium hydroxide to make alkene. Heat under reflux is needed. The reactions are called elimination reaction.

Examples

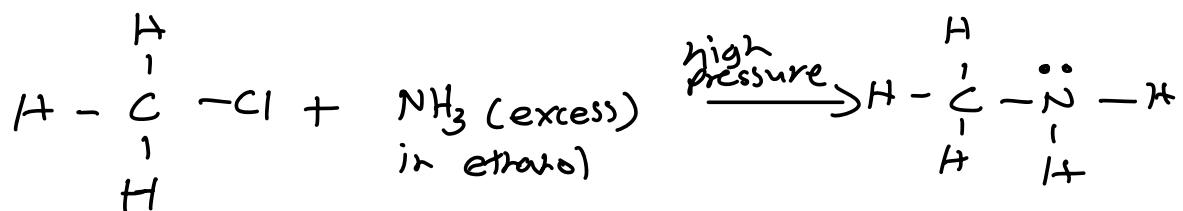
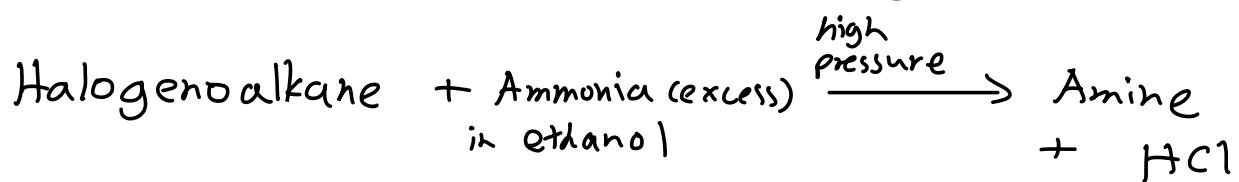




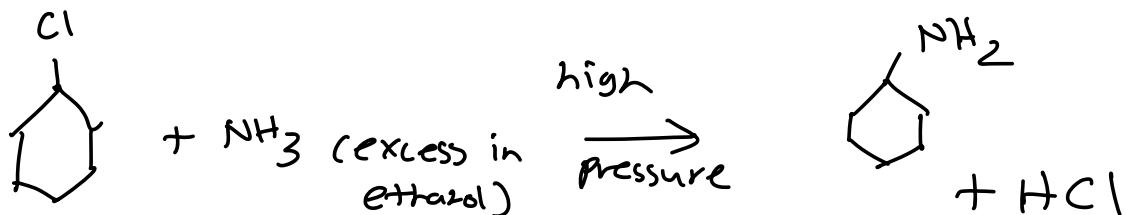
* Preparation of Amine from halogeno alkane

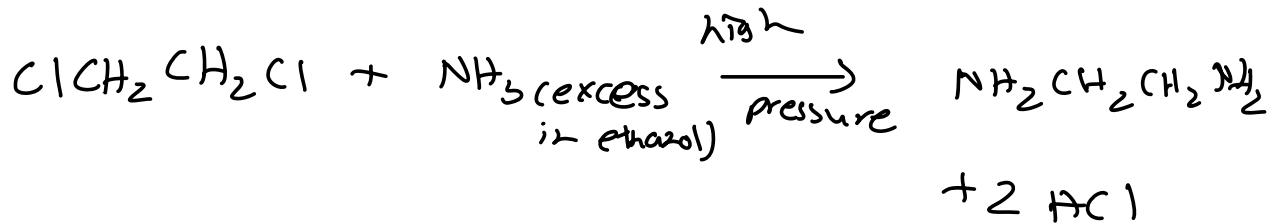
Halogeno alkanes react with excess ammonia to make amine.

High pressure is needed during the reaction.



* Ammonia is in excess or else product will react with reactant.

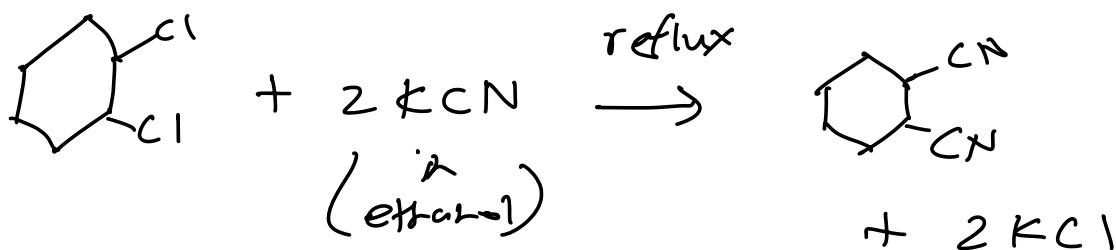
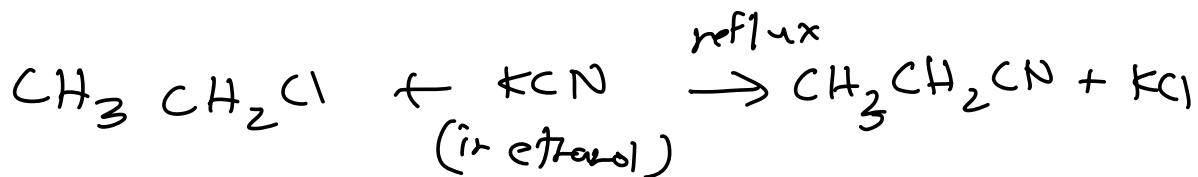




Preparation of nitrile compounds from halogenoalkane

⊖ Halogenoalkanes react with potassium cyanide (in ethanol) to make nitrile compounds.

⊖ Heat under reflux is needed during the reaction.

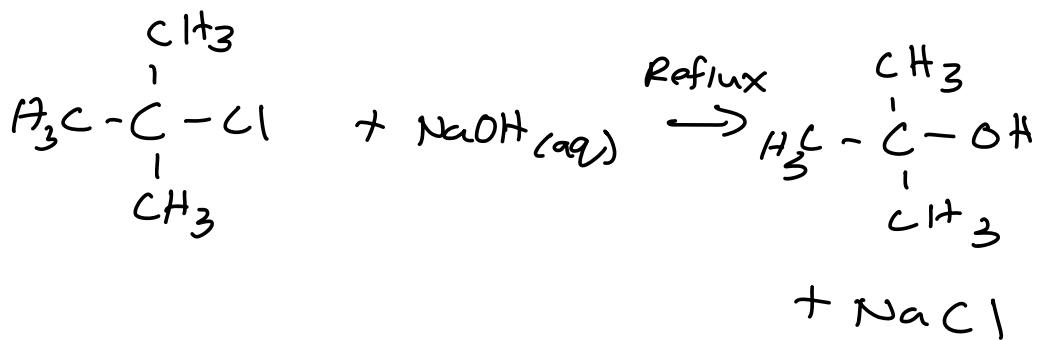


Reaction mechanism

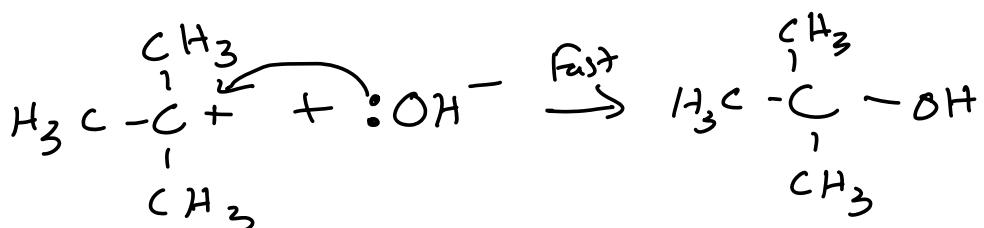
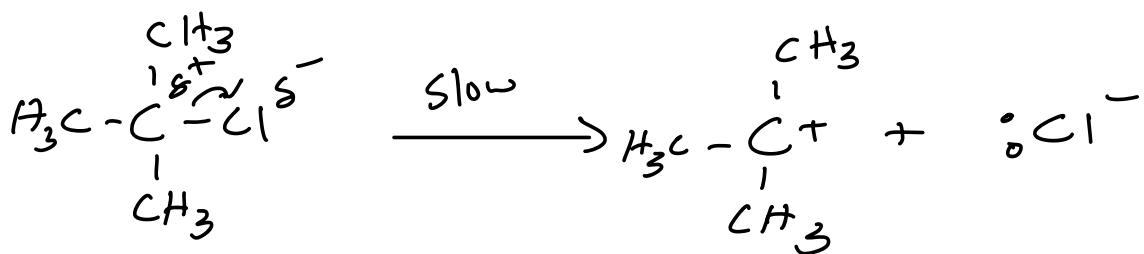
S_N^1

- ① Tertiary halogenoalkane represent S_N^1 mechanism.
- ② Rate of the reaction depends on the concentration of the halogenoalkane only.
- ③ Rate of the reaction is independent on the concentration of hydroxide ion.
- ④ Carbocation is formed before the formation of product

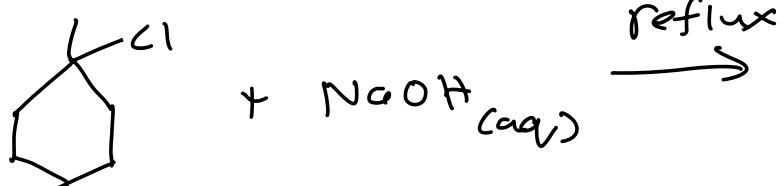
Reaction



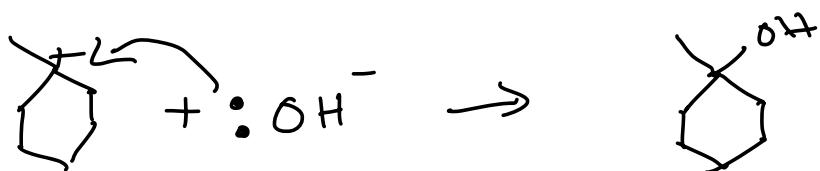
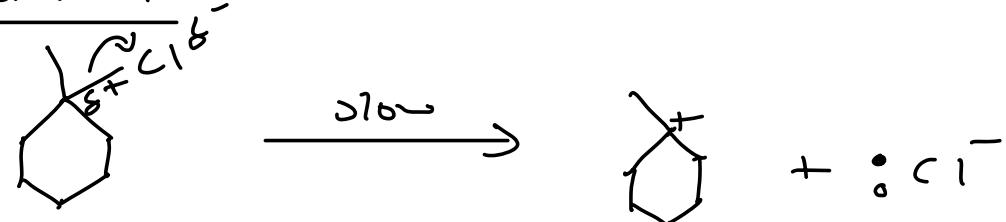
Mechanism



Reaction



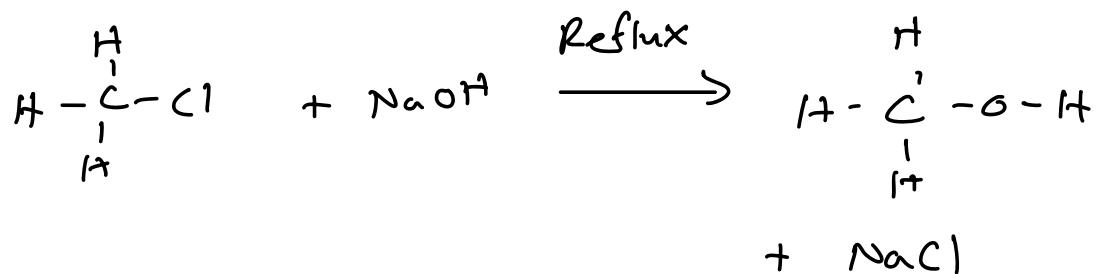
Mechanism



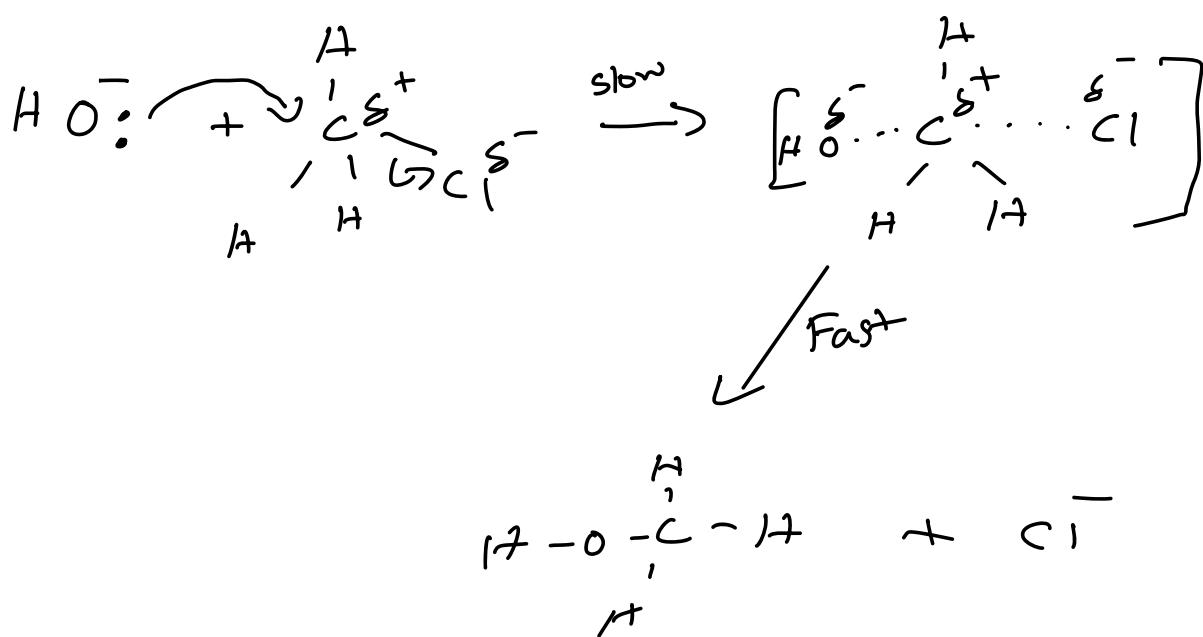
$\boxed{S_N^2}$

- ① Primary halogenoalkanes represent S_N^2 mechanism.
- ② Rate of reaction depends on the concentration of halogenoalkane and sodium hydroxide.
- ③ Intermediate is a pentavalent.

Reaction



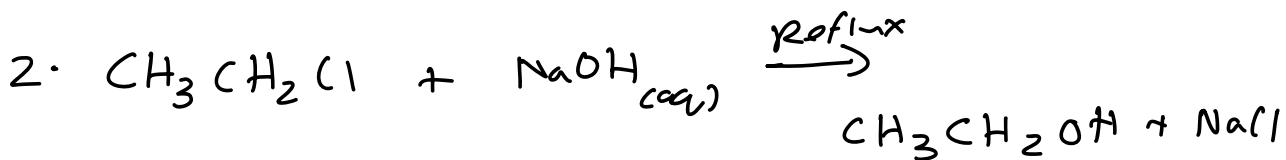
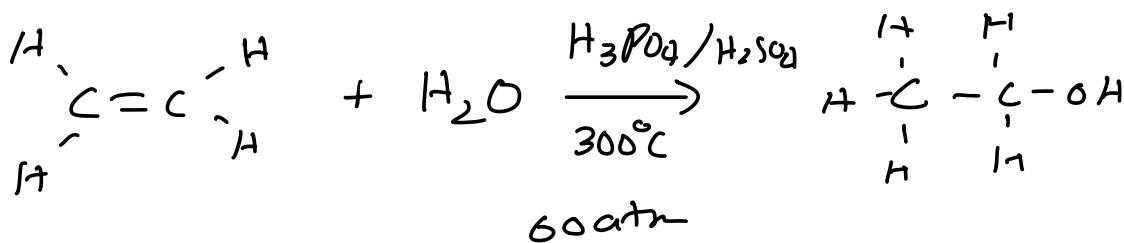
Mechanism



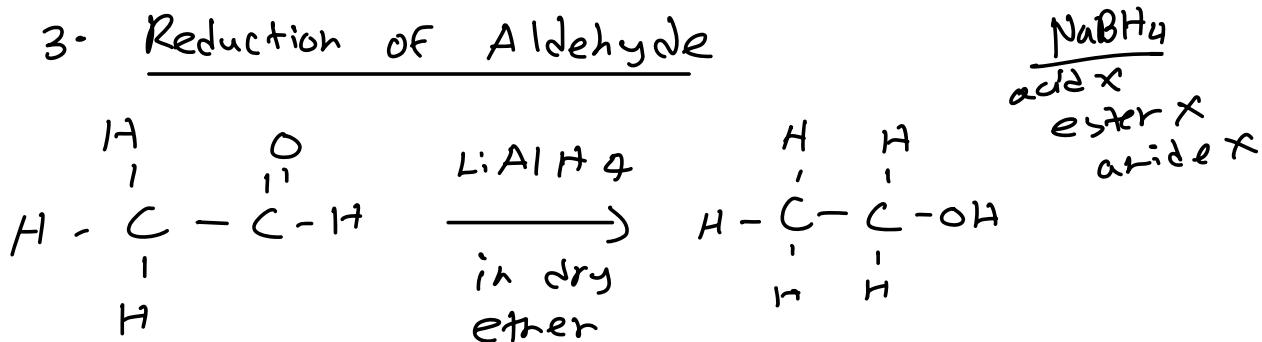
Alcohol, Carboxylic Acid and Ester

Preparation of Alcohol

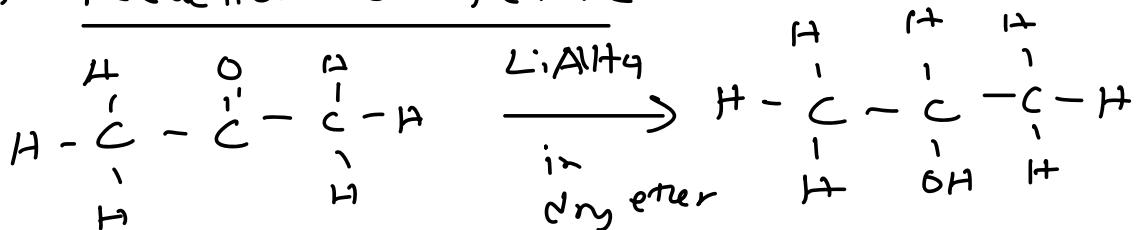
1. Hydration of Alkene



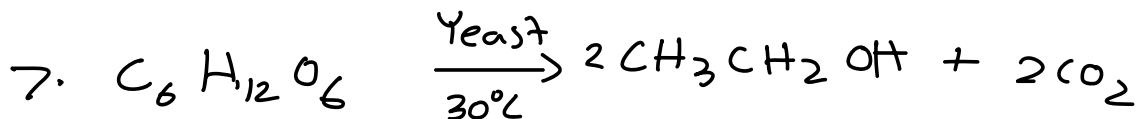
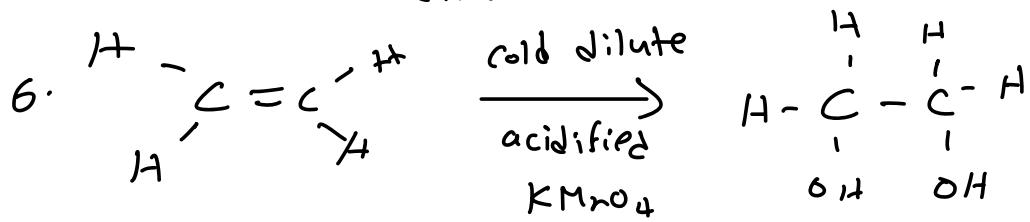
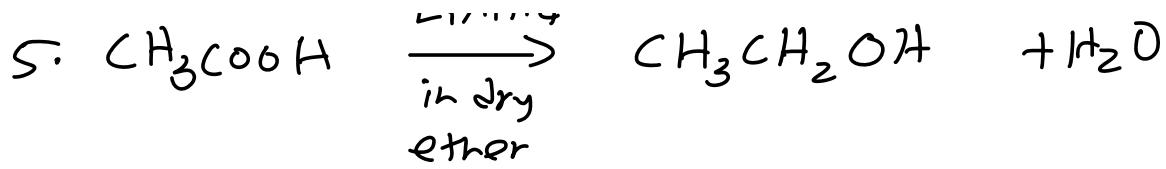
3. Reduction of Aldehyde



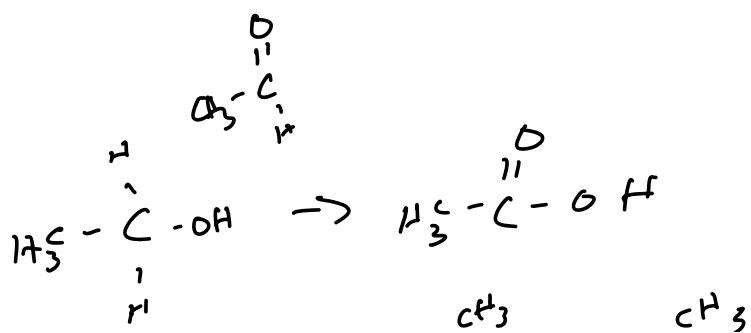
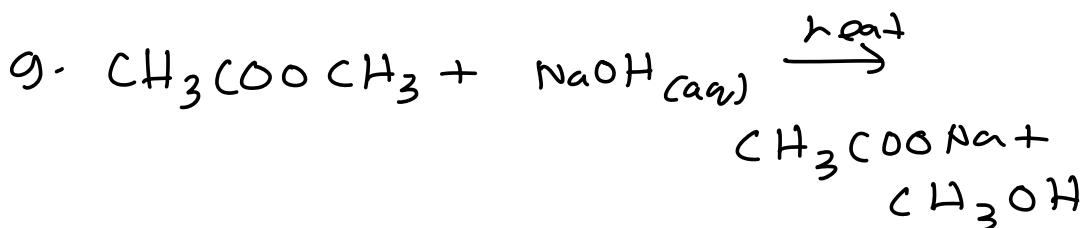
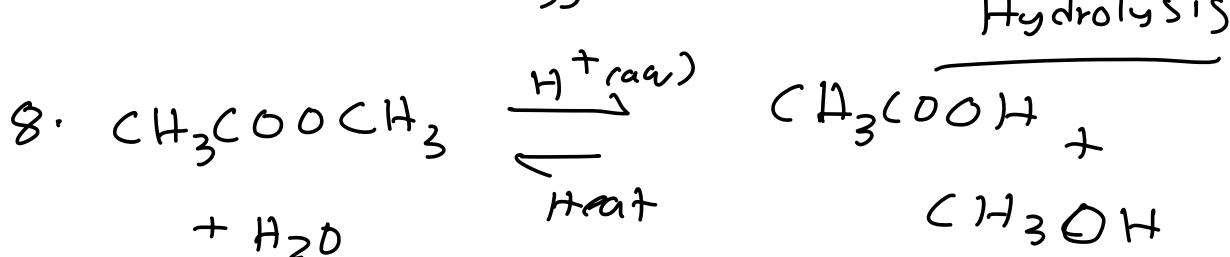
4. Reduction of Ketone



$1 : \text{AlH}_3$



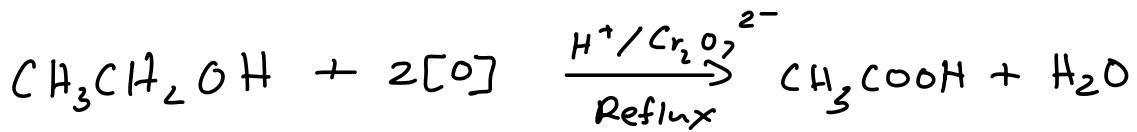
Absence
of
Oxygen



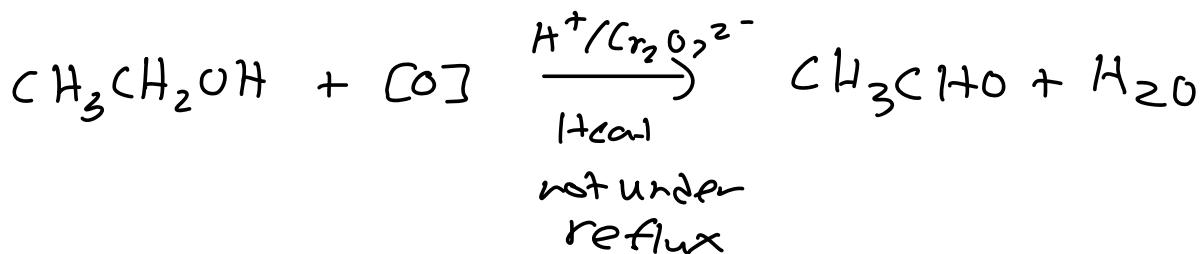
$\text{H}_3\text{C}-\overset{\text{H}}{\underset{\text{H}}{\text{C}}}-\overset{\text{OH}}{\underset{\text{H}}{\text{C}}}-\text{CH}_3$

Reactions of Alcohols

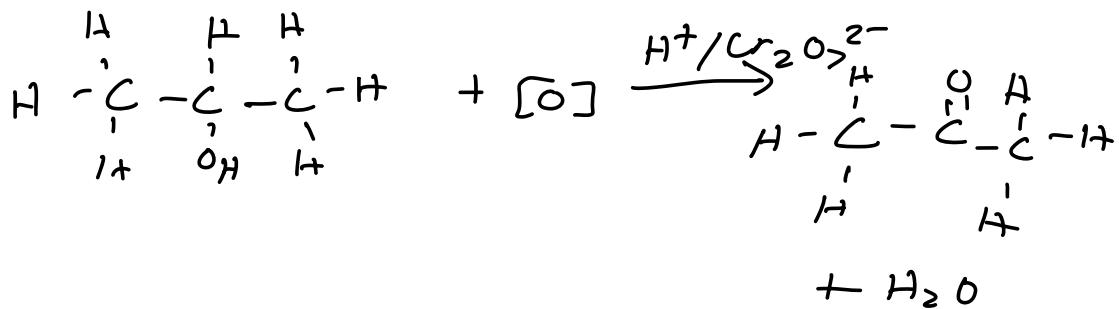
- (1) Oxidation of primary alcohol to make carboxylic acid.



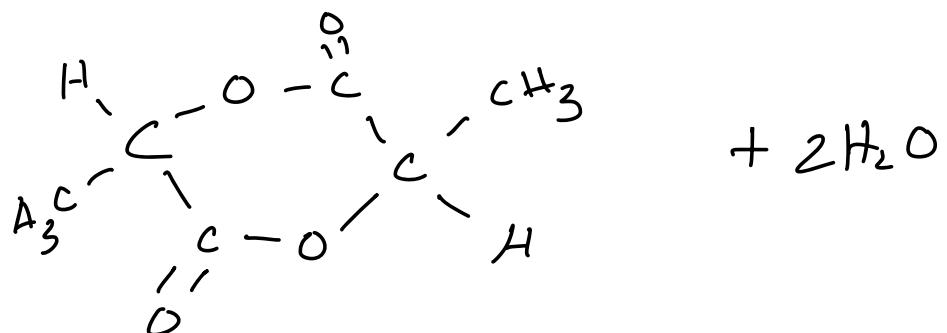
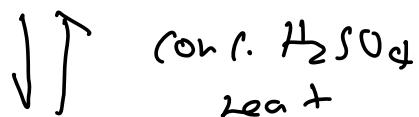
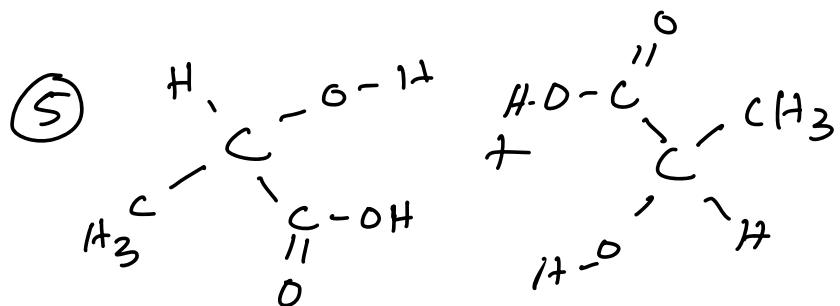
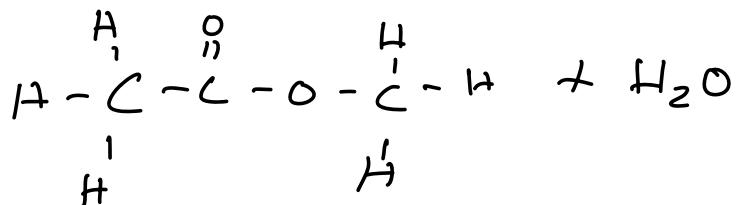
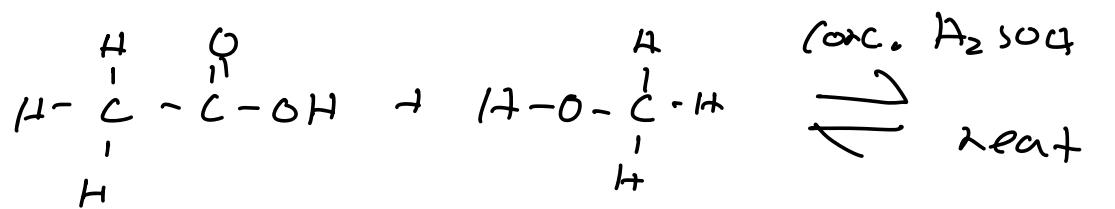
- (2) Oxidation of primary alcohol to make aldehyde



- (3) Oxidation of secondary alcohol to make ketone



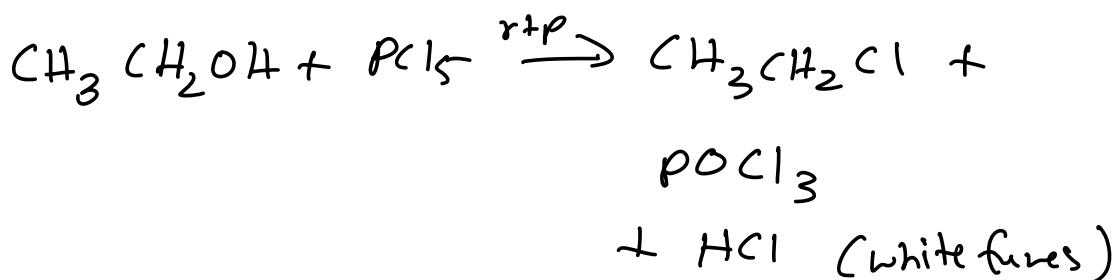
④ Esterification



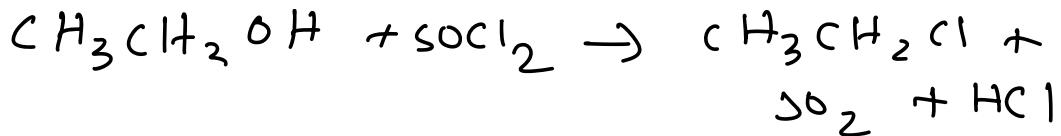
⑥ Combustion Reaction



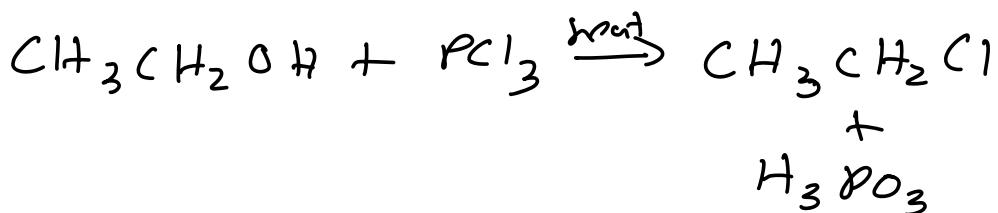
⑦ Reactions of alcohols with PCl_5 at rtp



⑧ Reactions of Alcohol with SOCl_2



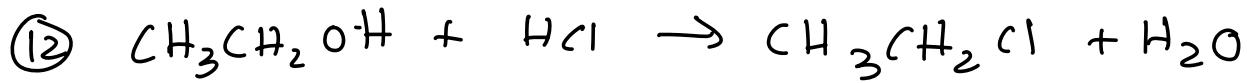
⑨ Reactions of Alcohol with PCl_3



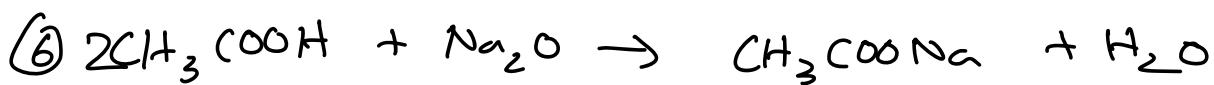
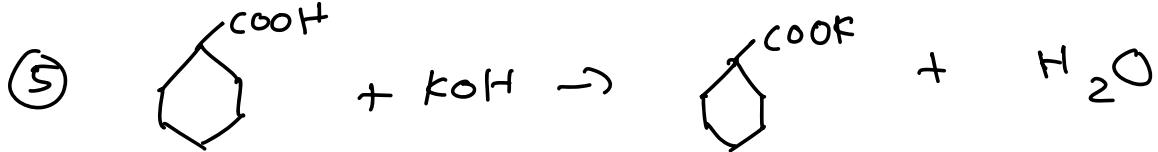
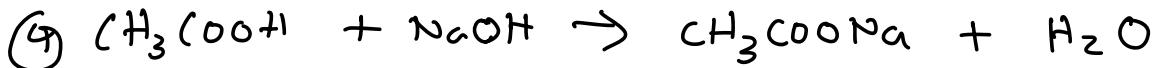
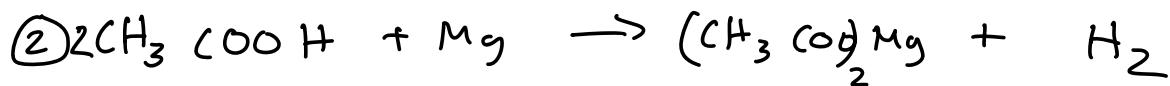
⑩ Reactions of Alcohol with sodium



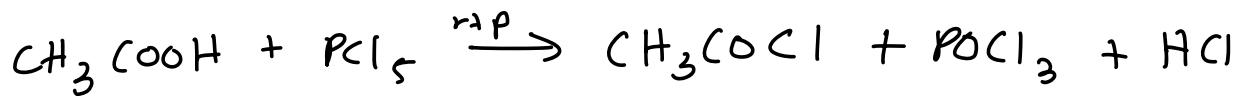
sodium ethoxide



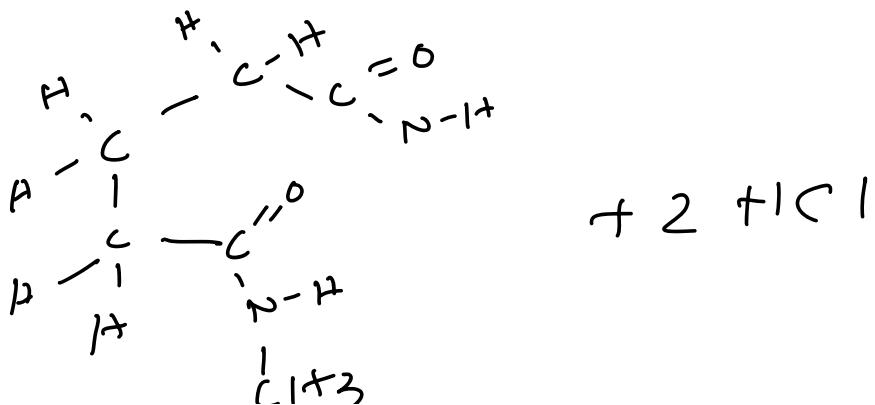
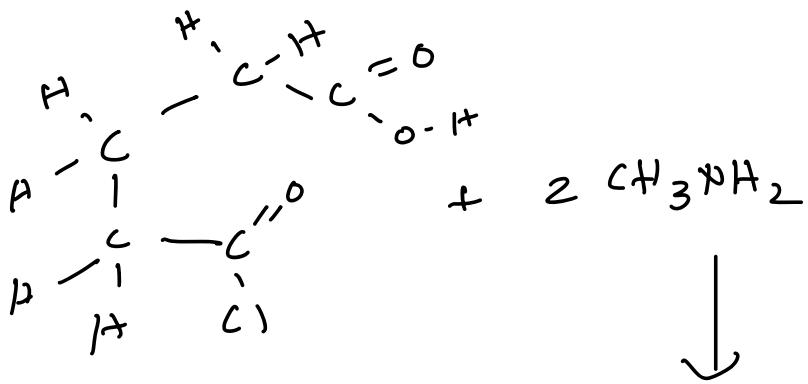
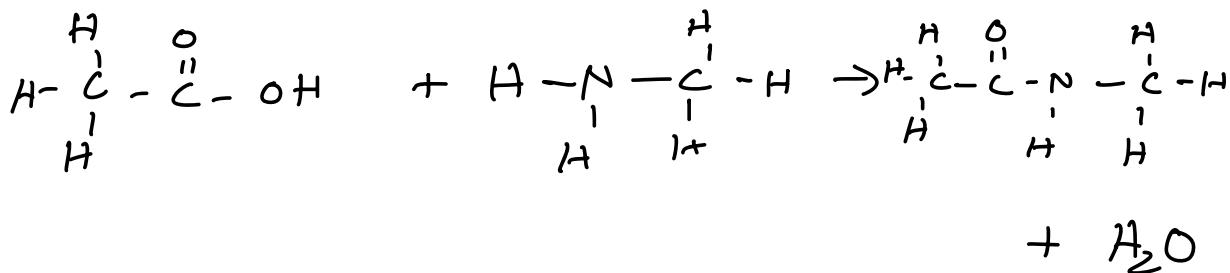
Reactions of Carboxylic acids

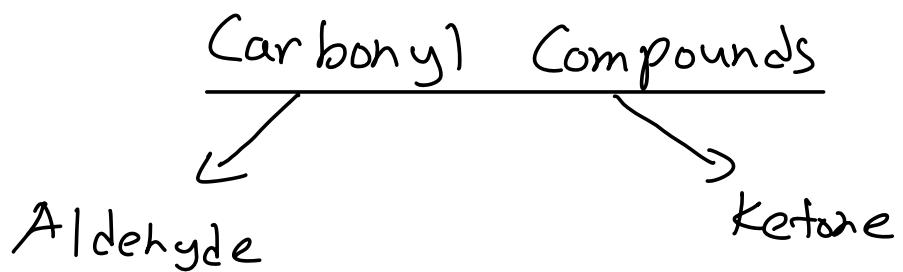


Reactions of carboxylic acids with PCl_5 , SOCl_2

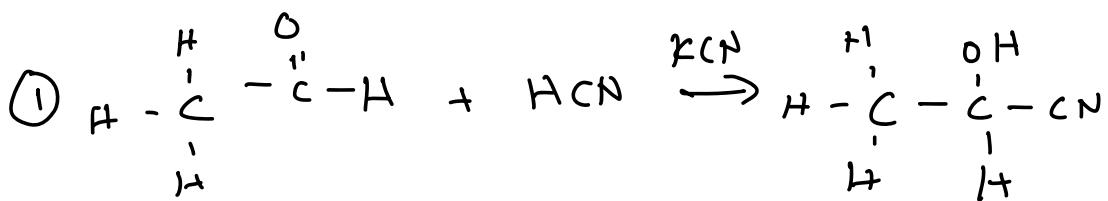


Reactions of carboxylic acid with amine to make amide

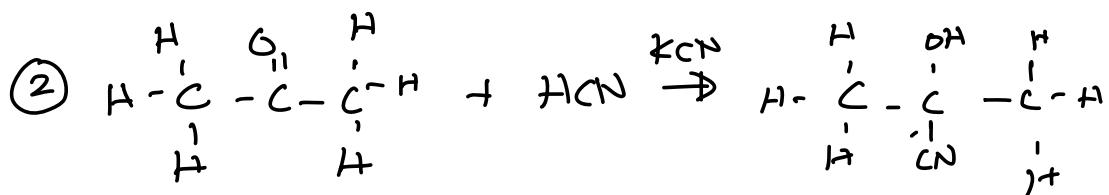




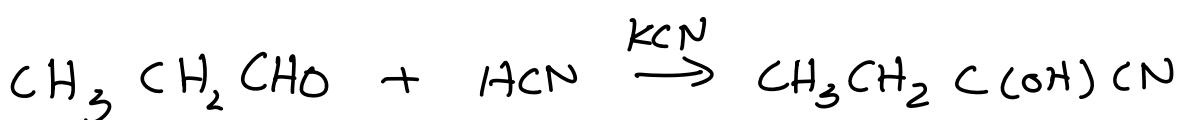
Reactions of carbonyl compounds



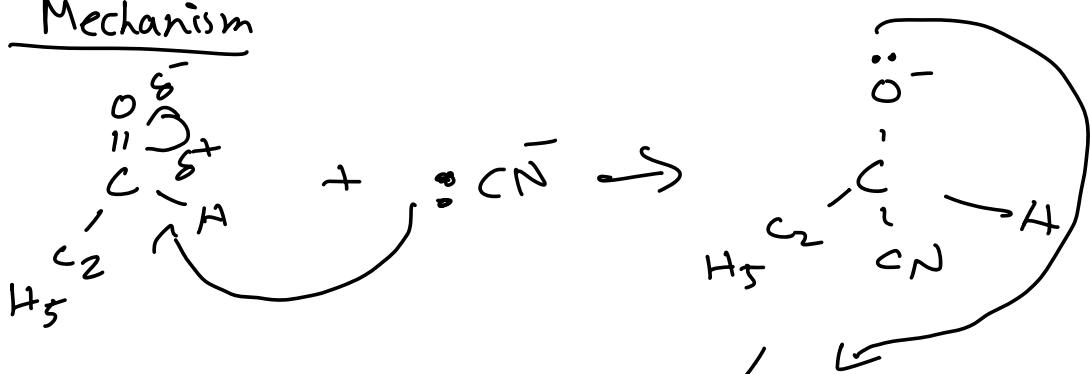
(cyano hydrine)

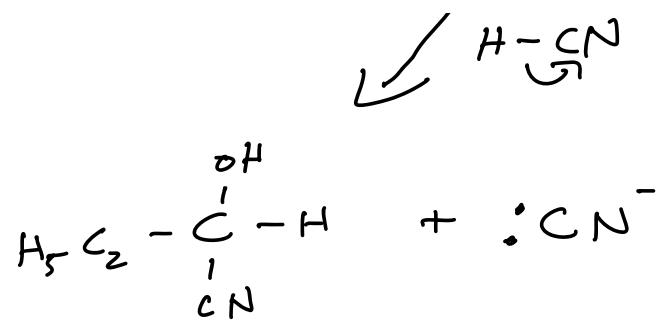


Reaction



Mechanism

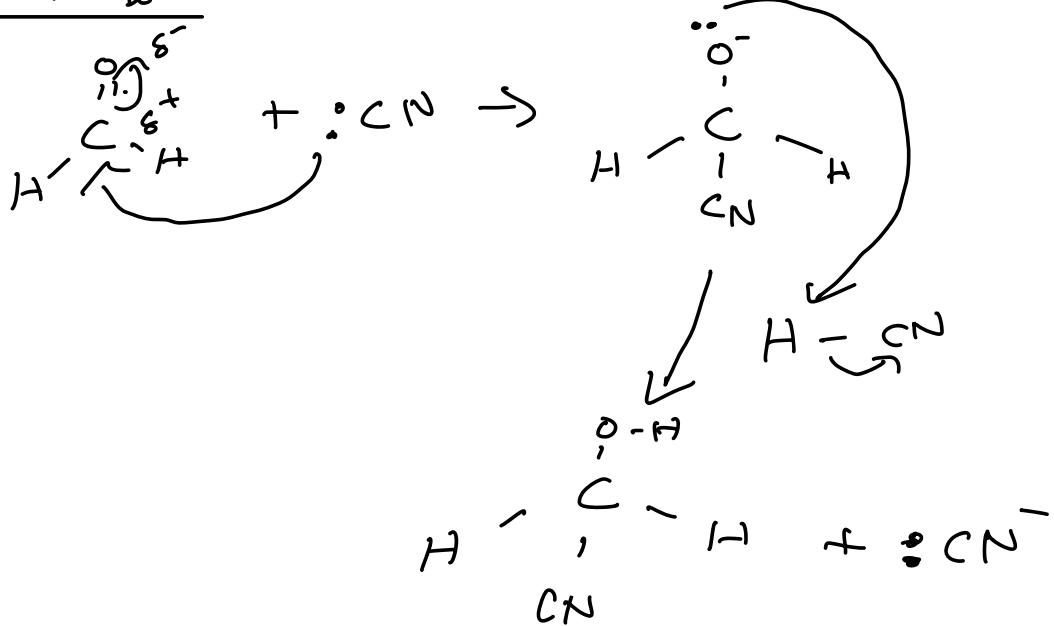




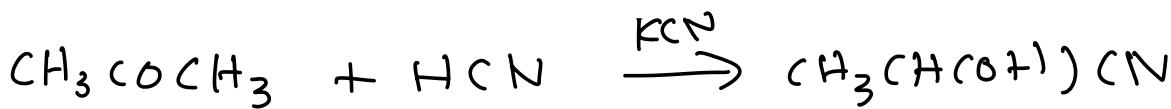
Reaction



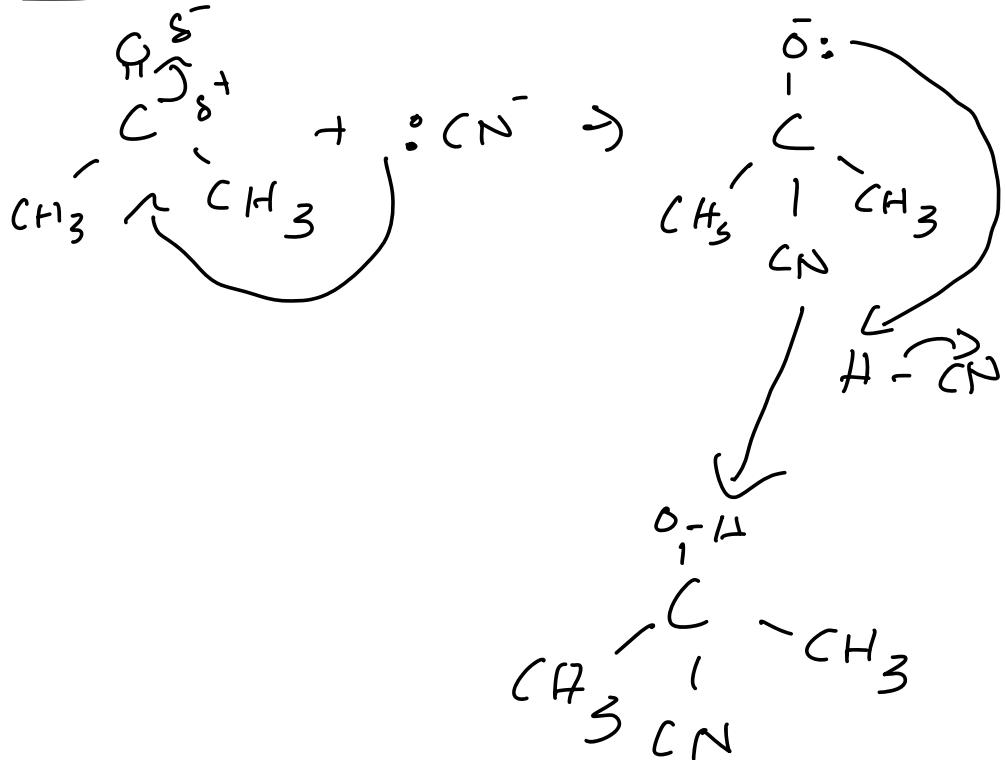
Mechanism



Reaction



Mechanism

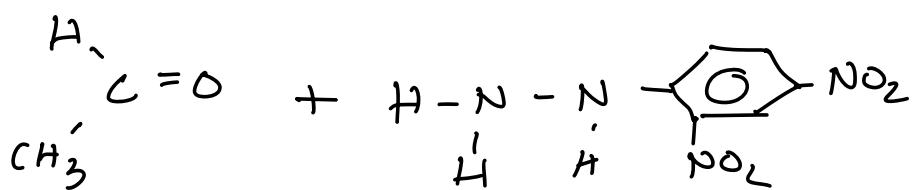


Identification of the carbonyl compounds

Test: Add 2,4-DNPH
(*2,4-dinitrophenylhydrazine*)

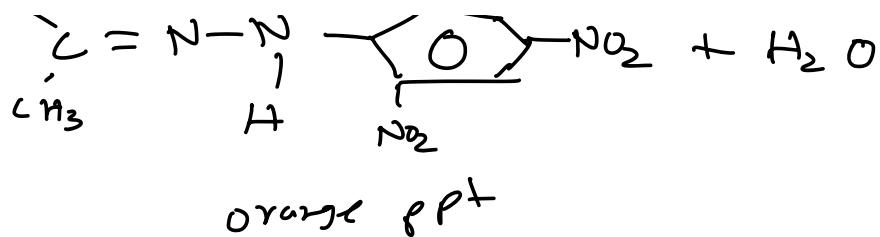
Observation: Orange ppt formed

Reactions



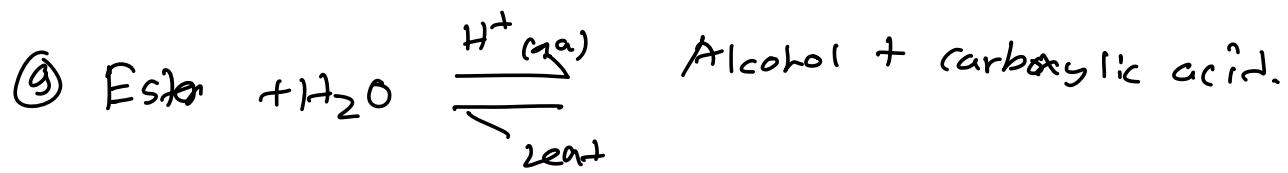
Condensation

H.

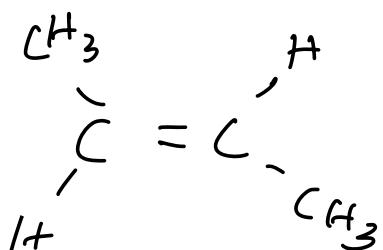
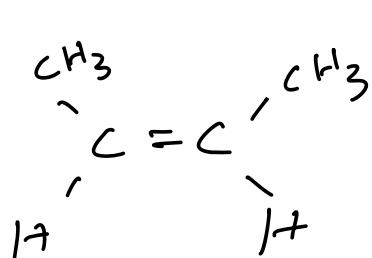
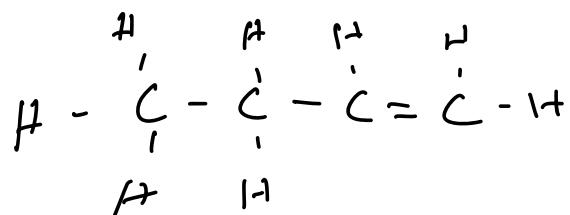
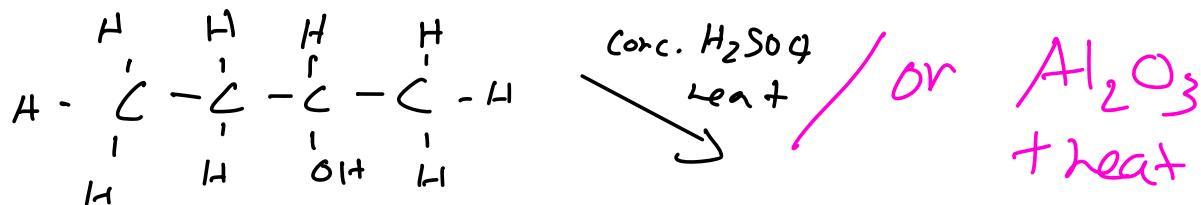


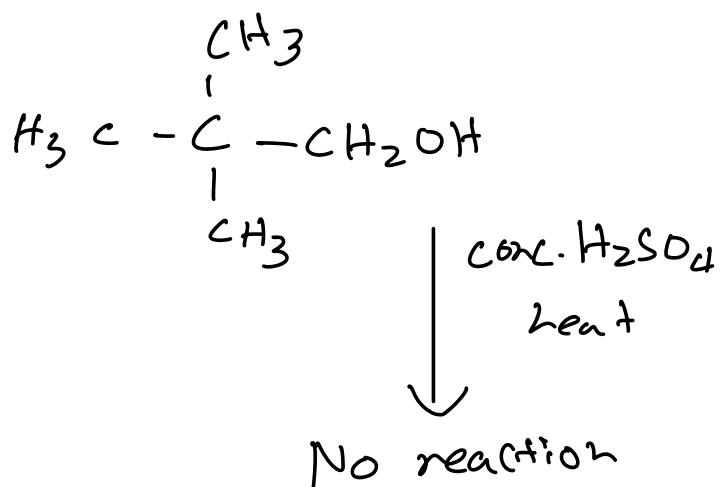
- ① Nitrile compound $\xrightarrow[\text{Reflux}]{\text{H}^+(\text{aq})}$ Carboxylic acid
- ② Nitrile compound $\xrightarrow[\text{Reflux}]{\text{NaOH}(\text{aq})}$ Salt of the carboxylic acid.
- ③ Nitrile compound $\xrightarrow[\text{in dry ether}]{\text{LiAlH}_4}$ Amine
- ④ $\text{C}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C}$ $\xrightarrow[\text{concent. H}_2\text{SO}_4]{\text{heat}}$ $\text{C}=\text{C}-\text{C}-\text{C}-\text{C}-\text{C}=\text{C}$
+ 2 H₂O
- ⑤ HO-C-C-C-C-C-OH + 2 Na \rightarrow NaO-C-C-C-C-C-ONa
+ H₂
- ⑥ Aldehyde $\xrightarrow[\text{heat}]{\text{Tollen's reagent}}$ Silver mirror
- ⑦ Aldehyde $\xrightarrow[\text{solution}]{\text>Fehling's}}$ brick-red ppt.
- ⑧ Ketone $\xrightarrow{\text{Tollen's}}$ no reaction

reager

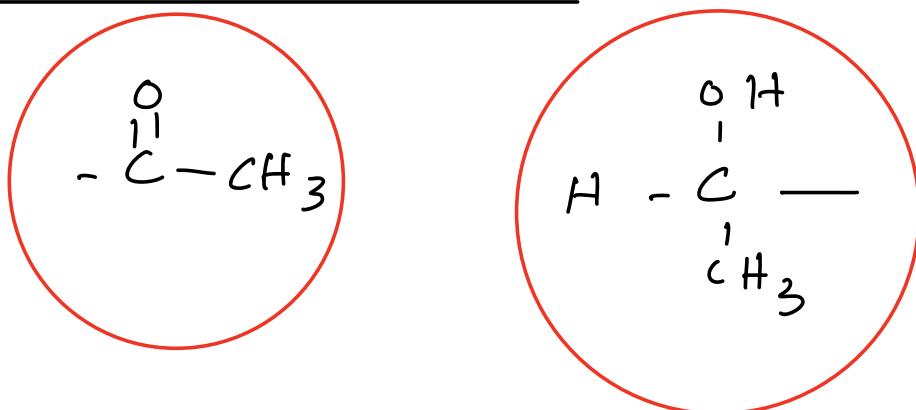
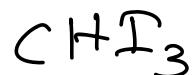


Dehydration of Alcohol





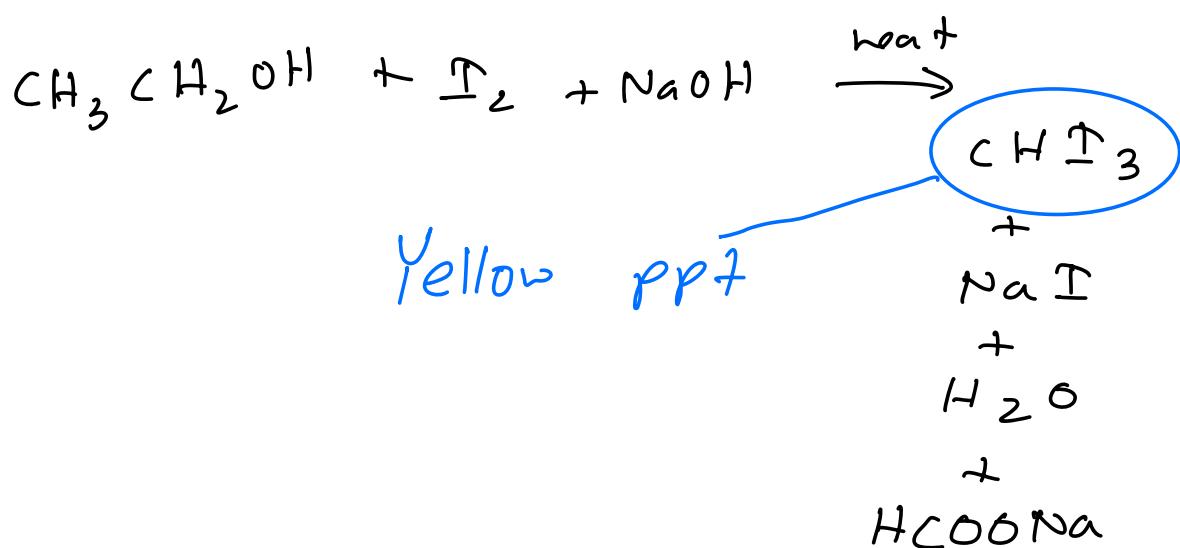
Iodoform reaction

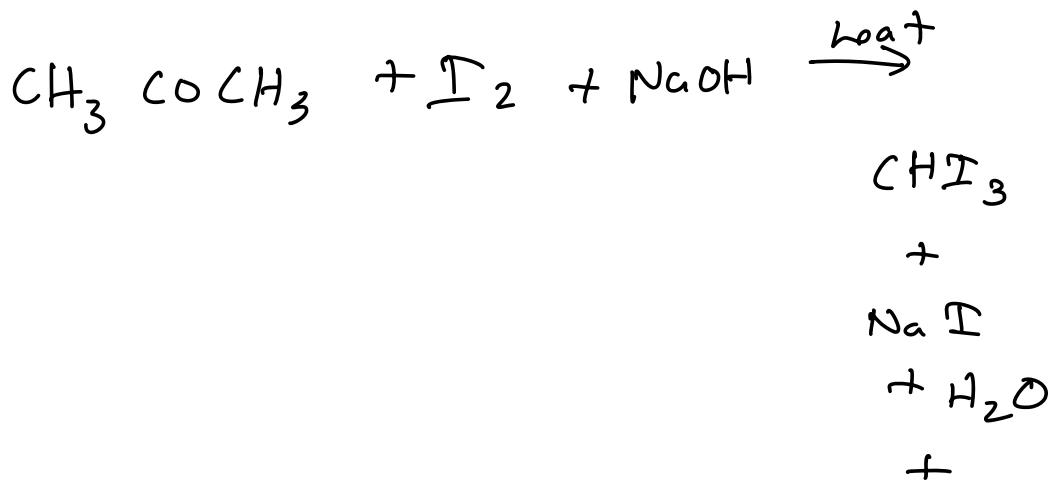
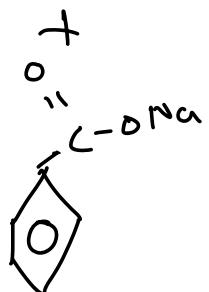
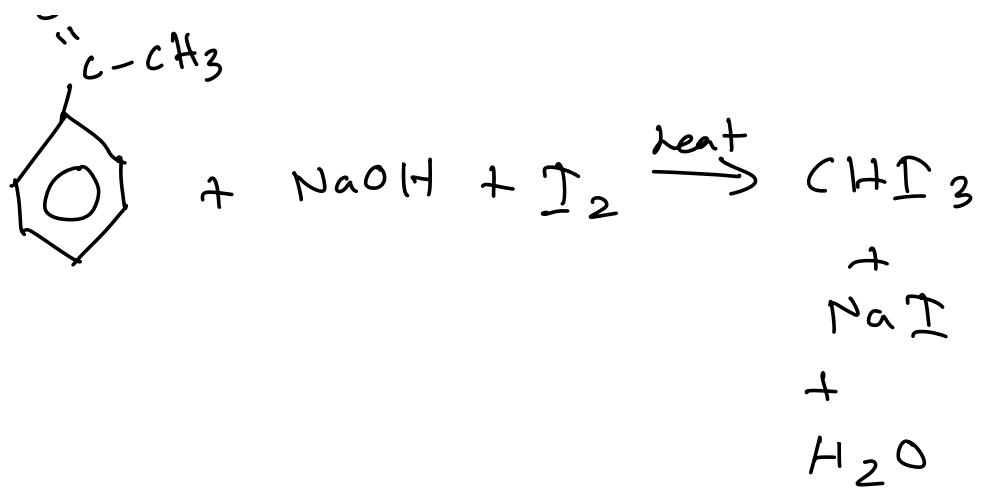


- ① Alcohol and carbonyl compounds can represent the iodoform reaction.
- ② In the case of primary alcohol only ethanol represent iodoform reaction

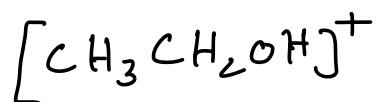
- ⑥ In the case of secondary alcohol, only 2-ol represent iodoform reaction.
- ⑦ Tertiary alcohol can not represent iodoform reaction.
- ⑧ In the case of the aldehyde only, ethanal represent iodoform reaction.
- ⑨ In the case of ketone, only 2-one represent iodoform reaction.

Examples

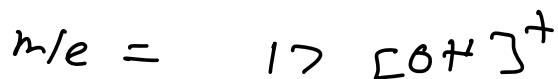




Mass Spectrometry



$$m/e = 46$$

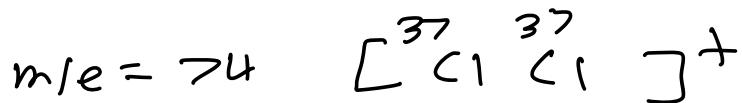


propanone	propanal
$\text{CH}_3 - \overset{\text{O}}{\underset{\text{C}}{\text{C}}} - \text{CH}_3$	$\text{CH}_3\text{CH}_2\text{CHO}$
$m/e = 58 \quad [\text{CH}_3\text{COCH}_3]^+$	$m/e = 58 \quad [\text{CH}_3\text{CH}_2\text{CHO}]^+$
$m/e = 17 \quad [\text{CH}_3]^+$	$m/e = 15 \quad [\text{CH}_3]^+$
$m/e = 43 \quad [\text{CH}_3\text{CO}]^+$	$m/e = 29 \quad [\text{CH}_3\text{CH}_2]^+$
	$m/e = 29 \quad [\text{CHO}]^+$
	$m/e = 43 \quad [\text{CH}_2\text{CHO}]^+$

Chlorine molecules (Cl_2)

Five groups of peaks

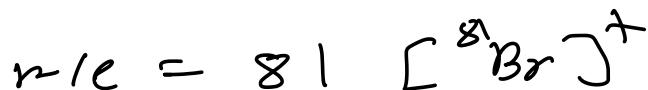
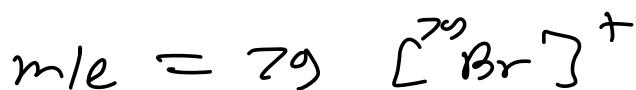
$\text{Cl} = 35 \quad 75\%$
 $\text{Cl} = 37 \quad 25\%$



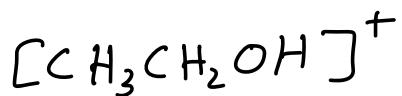
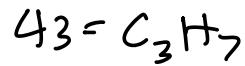
Bromine Molecules



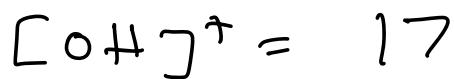
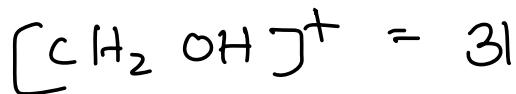
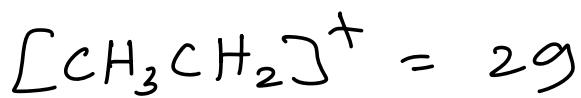
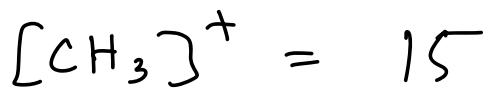
$\text{Br} = 79 \quad 50\%$
 $\text{Br} = 81 \quad 50\%$



Ethanol

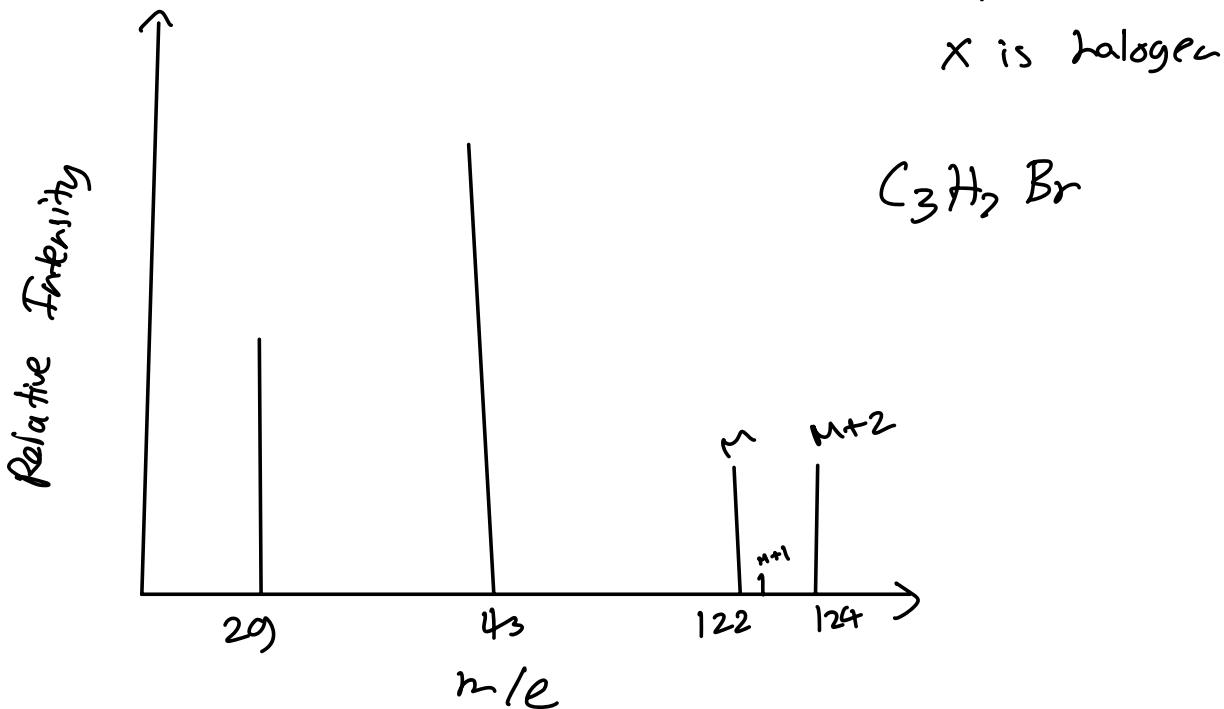


$$m/e = 46$$



Mass spectrum of C_2H_5X

X is halogen



The relative height of the M and M+1 peaks are 9 and 0.3 respectively.

$$\text{Number of carbon} = \frac{100}{1.1} \times \frac{M+1}{M}$$

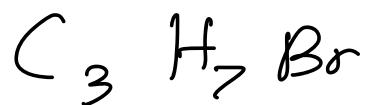
$$\frac{100}{1.1} \times \frac{0.3}{9}$$

$$\Rightarrow 3$$

$$M : M+2 = 1 : 1$$

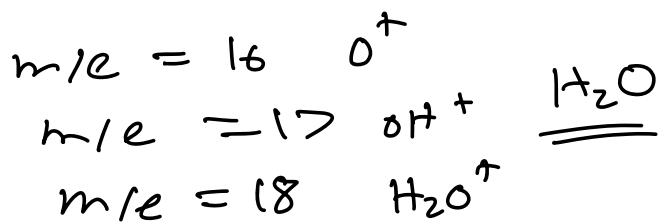
so the halogen is bromine

$$\begin{aligned}\text{Number of hydrogen} &= (12 - 3 \times 12 - 79) \\ &\Rightarrow 7\end{aligned}$$

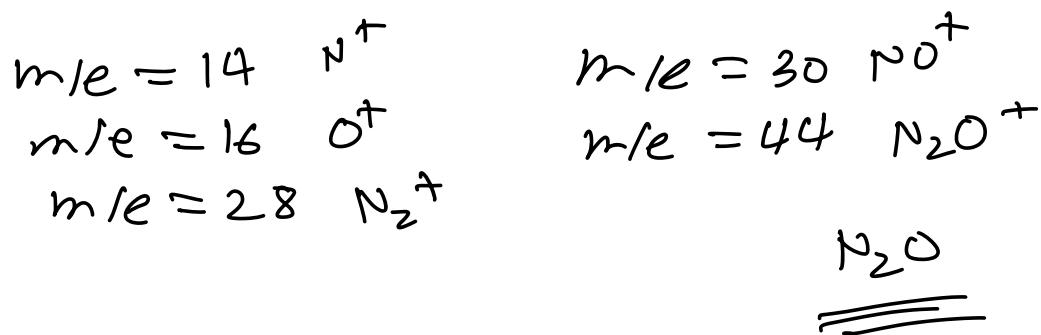




The mass spectrum of gas A contains peaks at



The mass spectrum of gas B contains peaks at

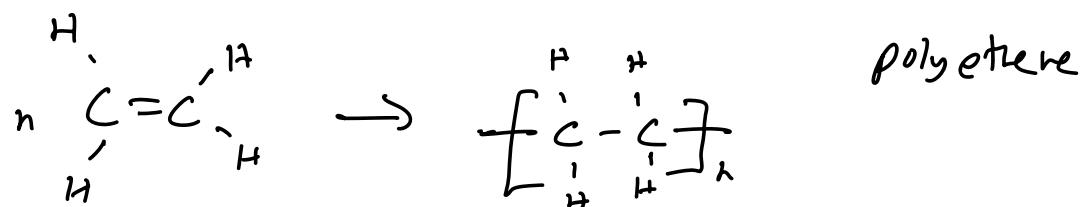


Polymer

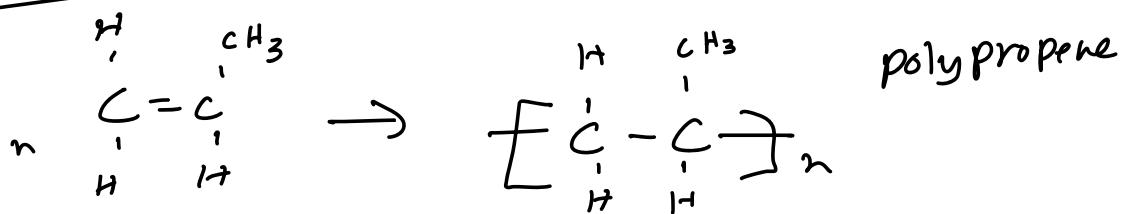
Addition Polymer

- ⊖ Monomers are unsaturated
- ⊖ Polymers are saturated.
- ⊖ Monomers can react with bromine solution.
- ⊖ Polymers can not react with bromine solution. which have C-C bonds only.
- ⊖ No by product

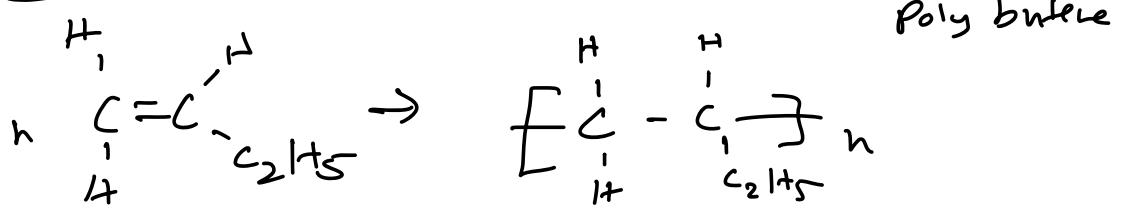
Example-1



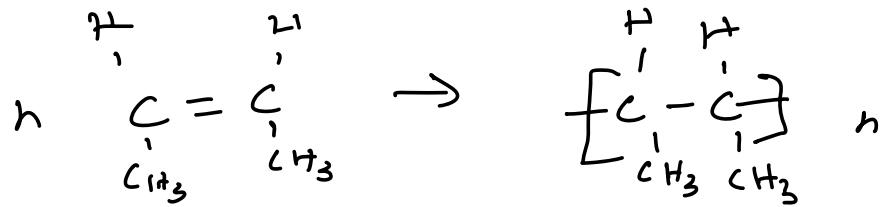
Example-2



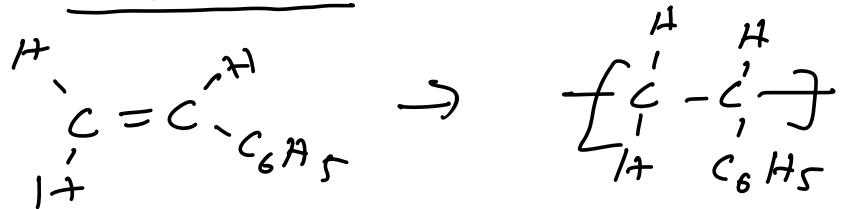
Example - 3



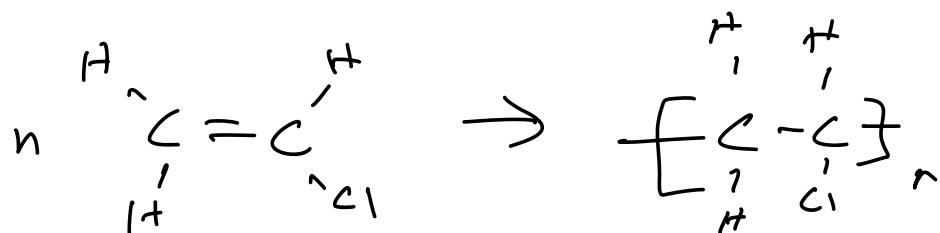
(4) Poly but-2-ene



(5) Poly styrene



(6) poly vinyl chloride (PVC)

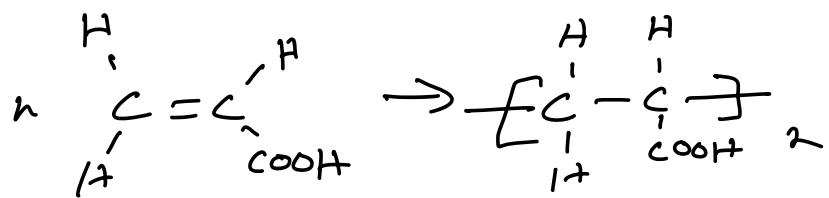


(7) Poly tetra fluoro ethene (Teflon)

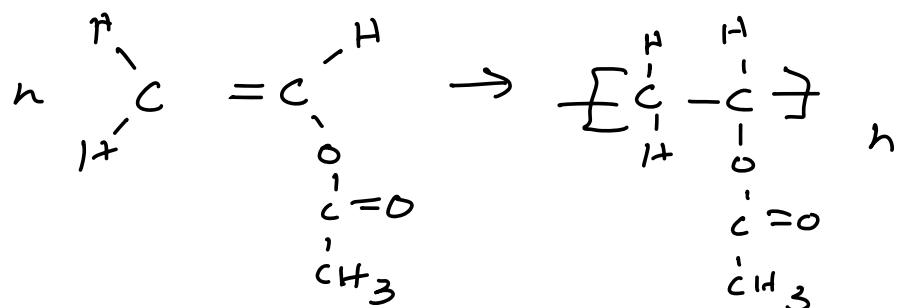


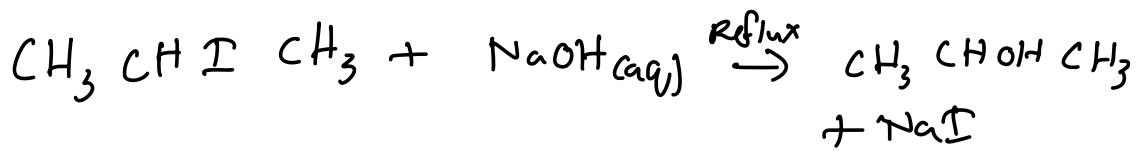
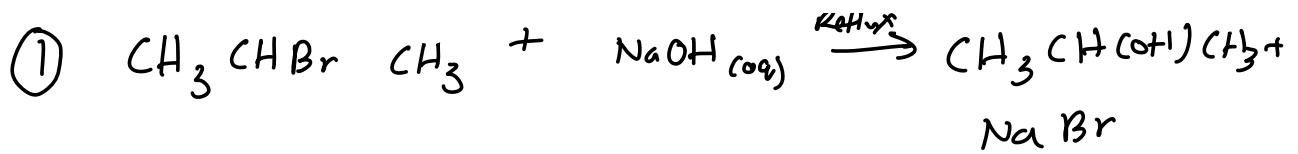


⑧ Poly propenoic acid



⑨ Poly vinyl acetate (PVA)



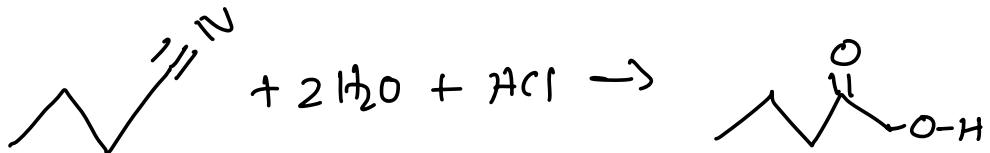
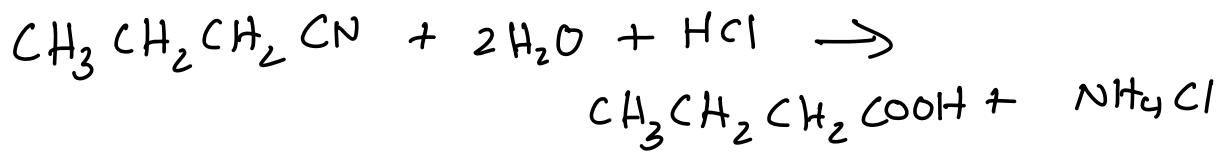


2-iodo propane reacts at a faster rate
than 2-bromo propane

Explanation

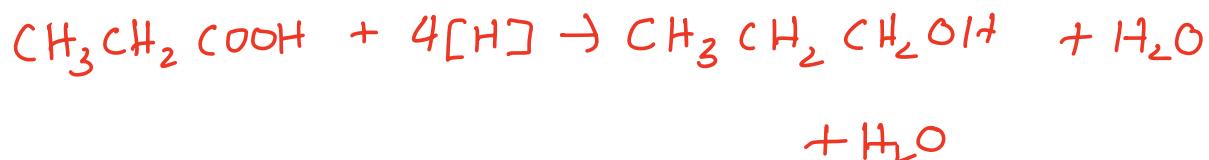
- Atomic radius of iodine is greater than bromine.
- C-I bond is weaker than C-Br bond.
- Less energy is needed to make the carbocation from 2-iodo propane.
- Lesser activation energy with 2-iodo propane.

② Acidic hydrolysis of nitrile compound





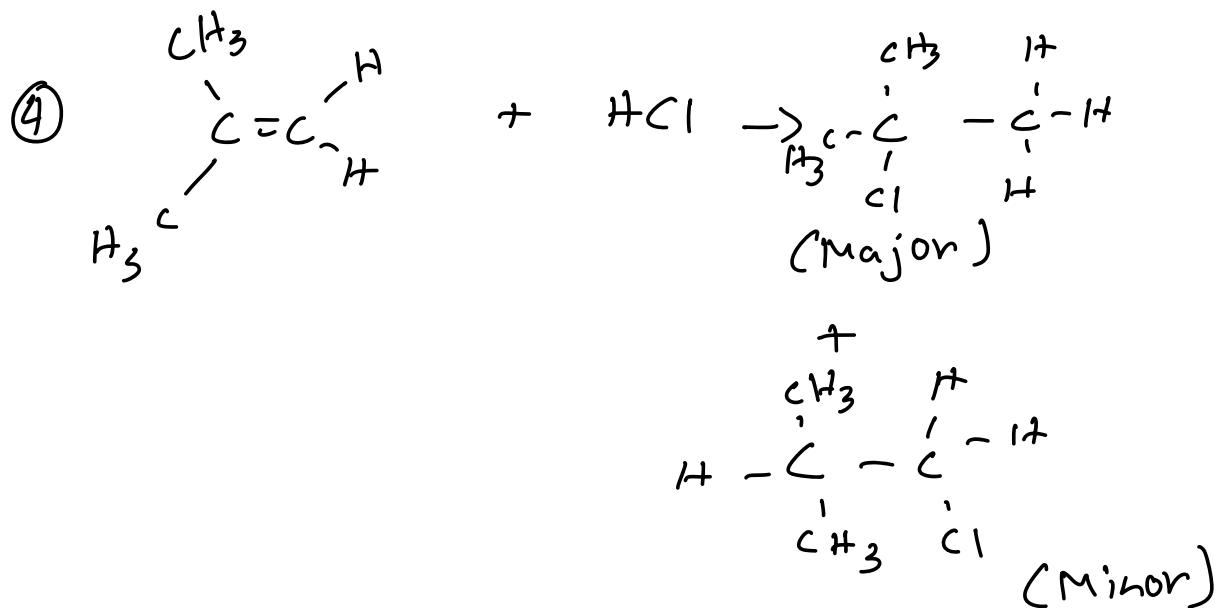
③ Reduction of carboxylic acid



Reducing agent

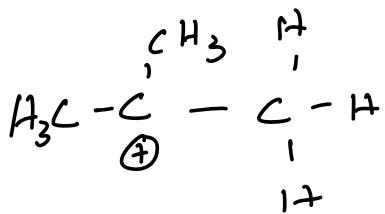
LiAlH_4 in dry ether

(Lithium tetra hydride aluminate)

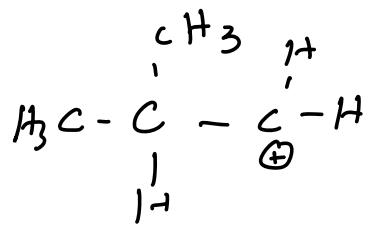


2-chloro-2-methyl propane is produced in a higher yield than 1-chloro-2-methyl propane.

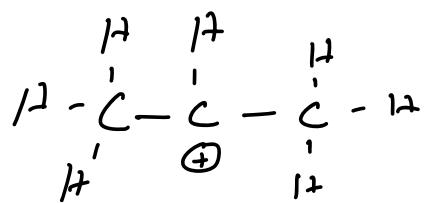
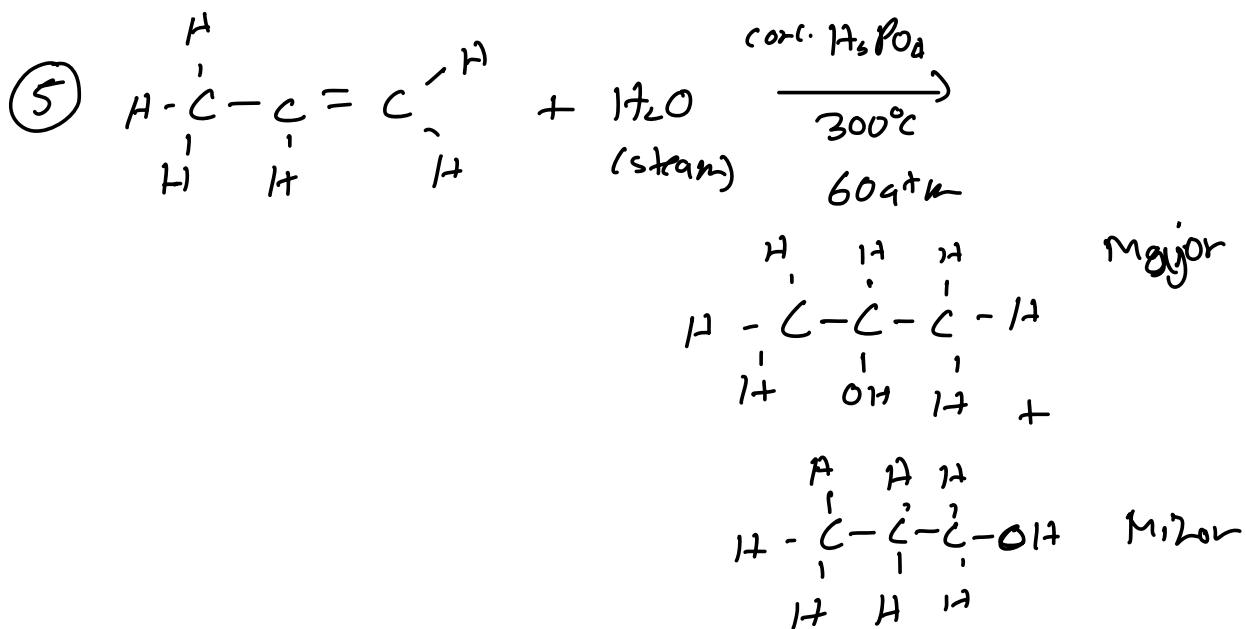
Explanation



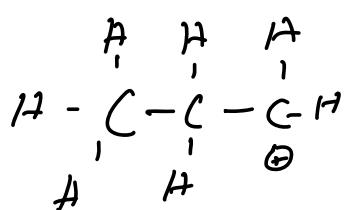
Less stable



More stable carbocation due to the greater (positive inductive effect caused by 3 methyl groups.)



More stable
Carbocation



Less stable
Carbocation

More alky l groups
cause greater
positive inductive
effect.

⑥ Alkenes react with electrophile
but alkynes don't

-
- ⑦ Alkenes contain only sigma bonds.
 - ⑧ Alkenes contain sigma bonds and pi(π) bond.
 - ⑨ Electrons in π of the C=C are responsible for the reaction
 - ⑩ Electrophiles are attracted in π/π .
 - ⑪ Reduction of the carbonyl compounds by using sodium tetrahydridoborate (NaBH_4) (in aq)

Lithium tetrahydrido aluminate
(LiAlH_4) in dry ether



$\text{Ni} + \text{H}_2 /$ to make alcohol

- COOH
- CN
- CHO
- $\begin{array}{c} \text{O} \\ \parallel \\ \backslash \quad / \\ \text{C} \end{array}$
- OH
- NH_2
- $\begin{array}{c} \text{C}=\text{C}' \\ \diagdown \quad \diagup \\ \text{C} \end{array}$
- $\text{C}\equiv\text{C}-$
- halogen
- alkyl

decreases



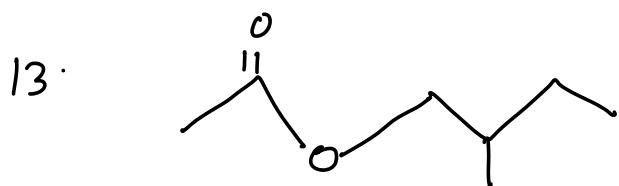
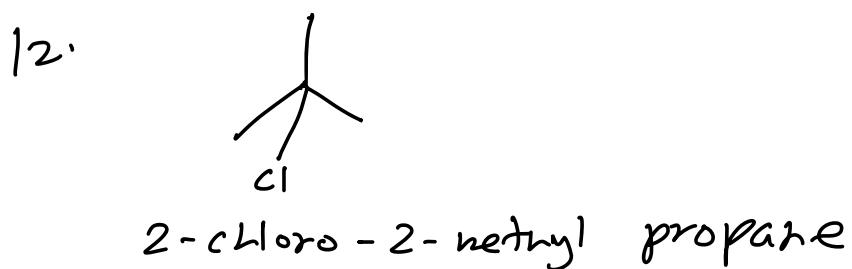
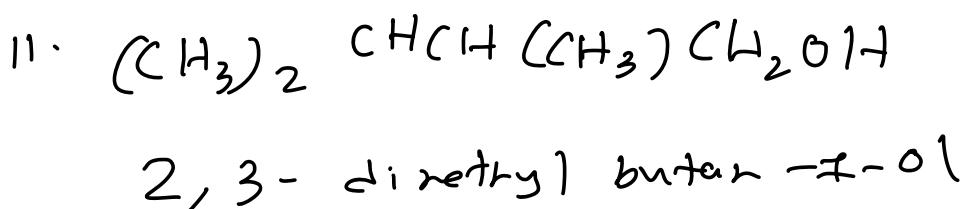
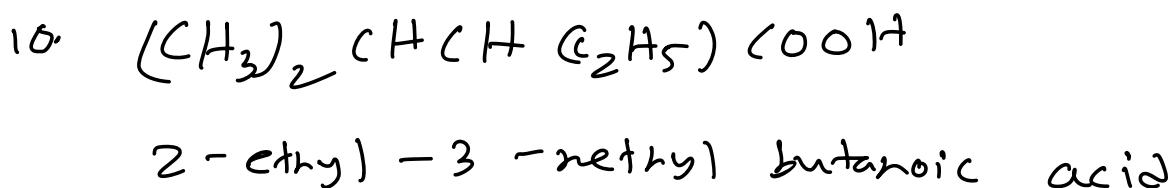
1. butan-1-ol

2. 2-bromo butane

3. 5-hydroxy hexanoic acid

4. 1,3-dichloro propan-2-one

5. 1,3-dichloro propan - 2-ol
6. 3 chloro - propane - 1,2-diol
7. 2-iodo - 2 methyl butane
8. propane - 1,2,3-triol
9. 3-hydroxy butan - 2-one



2-methyl butyl ethanoate

14. 2-iodo - 2-methyl propane

15. HOCH₂CH=CHCH₂OH
but-2-ene - 1,4-diol

16. 2-chloro pentan-3-one

17. ethanol-1,2-diol

18. 3-methyl pentan-2-one

19. pentan-2-one

20. 3,3-dimethyl pentan-2-one

21. but-1,3-diene

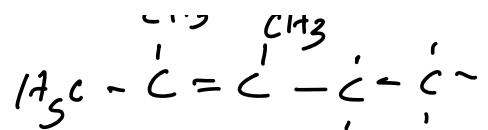
22. 2-methyl hexan-1,6-dioic acid

23. 1-chloro-1-methyl cyclohexane.

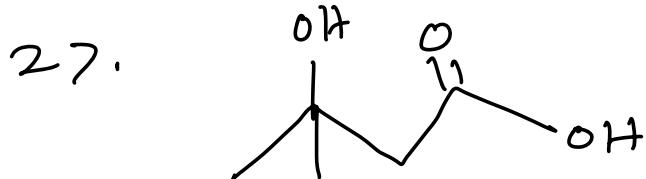
24. hexan-2-one

25. 3-hydroxy butan-2-one

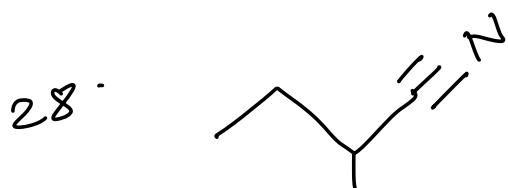
26. (CH₃)₂C=C(CH₃)CH₂CH₃
-H₂ ...



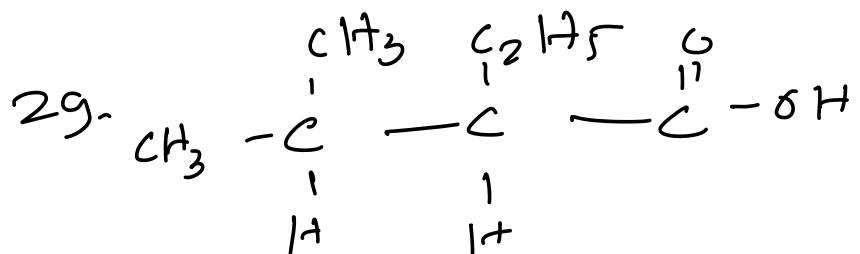
2,3-dimethyl-pent-2-ene



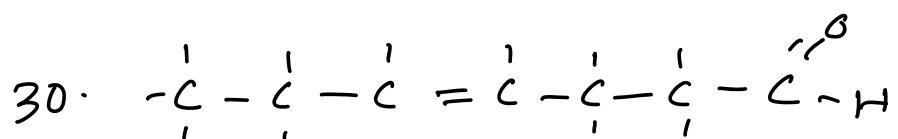
3-hydroxy-3-methylbutanoic acid



2-methylbutanenitrile



2-ethyl-3-methylbutanoic acid

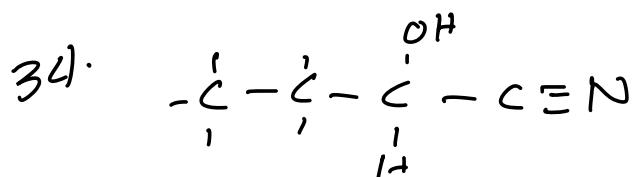


hept-4-enal

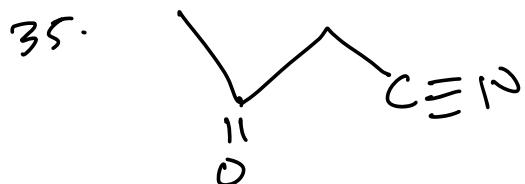
31. 4-bromo-pentan-2-ol

32. 3-oxo butanoic acid.

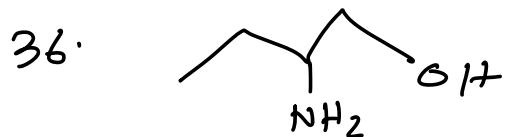
33. 3-methyl hexan-3-ol



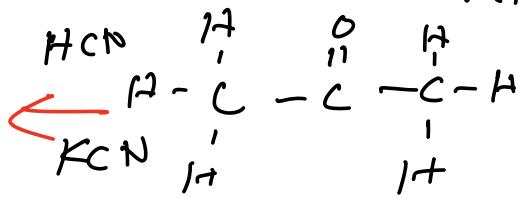
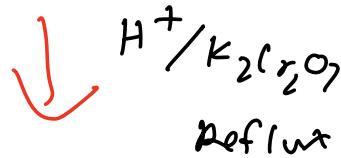
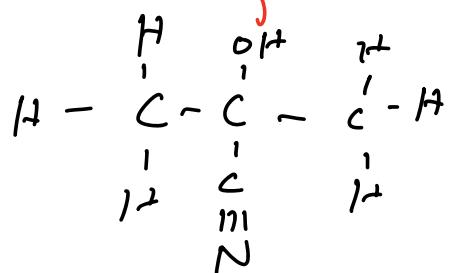
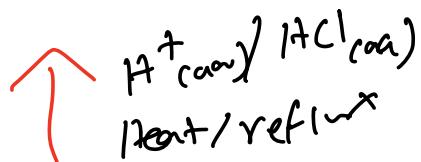
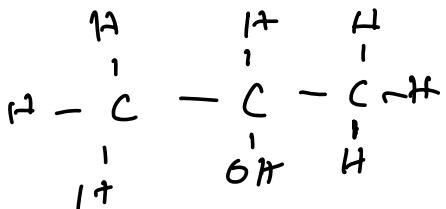
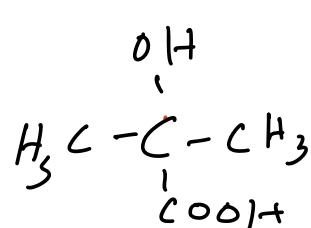
2-hydroxy butanenitrile



3-oxo butanenitrile



2-amino-butan-1-ol



* Carboxylic acids do not give positive I₂ test.

* butan-1-ol has higher boiling point than butan-2-ol, straight chain.