Alkenes Methods of Preparation → | ROR ∝ No. of R(alkyl substituent) |

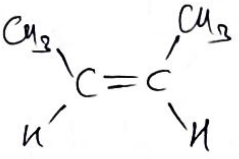
① Hydrogenation Rxn.

$$-C\equiv C- \xrightarrow[\text{OR}\ Pd-CaCO_3\ \text{OR}\ Pd-C]{+H_2,\ Pd-BaSO_4} -C=C-$$

$Pd-BaSO_4$ → Lindlar's catalyst

Syn-addition

Eg. $CH_3-C\equiv C-CH_3 \xrightarrow{+H_2,\ Pd-BaSO_4}$



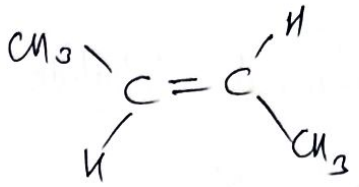
cis

② Birch Reduction → trans alkenes

$$-C\equiv C- \xrightarrow{(R)} -C=C-$$

(R) → Li or Na / Liq. NH_3

Eg. $CH_3-C\equiv C-CH_3 \xrightarrow{Li\ /\ Liq\ NH_3}$

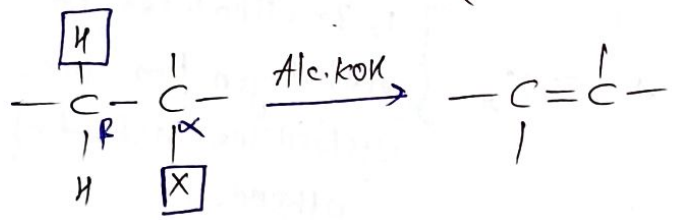


trans

③ Dehydrohalgeration Rxn.

Alkyl halide $\xrightarrow{(R)}$ Alkene

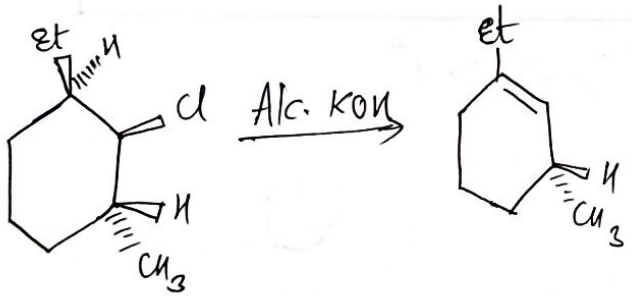
(R) → alcoholic KOH or sodium ethoxide (EtO^-Na^+)



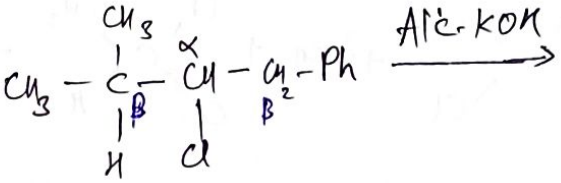
Eg. $CH_2-CH_2-Cl \xrightarrow{\text{Alc. KOH}} CH_2=CH_2 + KCl + H_2O$

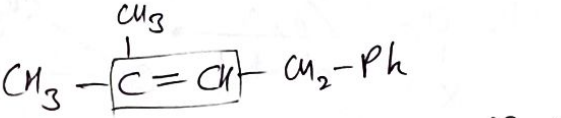
Imp. Pt:

① Anti elimination



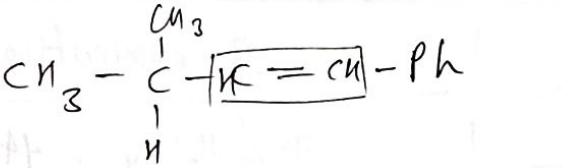
② More stable product is the major product





(~~Major~~) Minor Saytzeff Product

+



(~~Minor~~) Major Hoffmann product

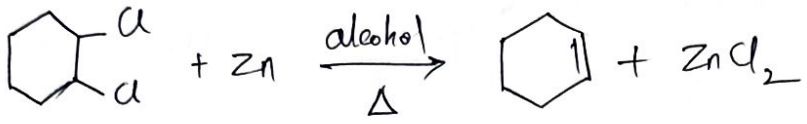
→ No Carbocation

→ No Rearrangement

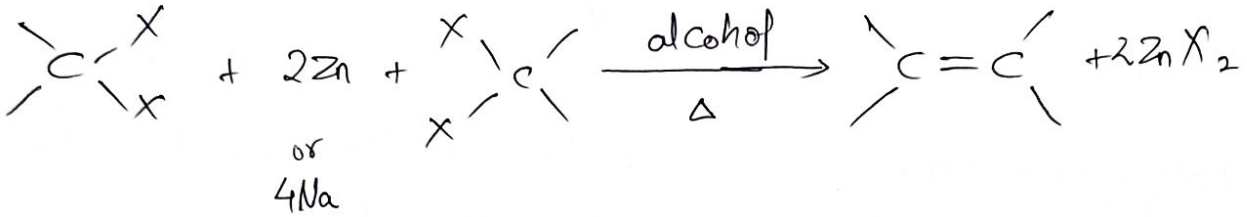
(4) By Dehalogenation of Vicinal dihalides:

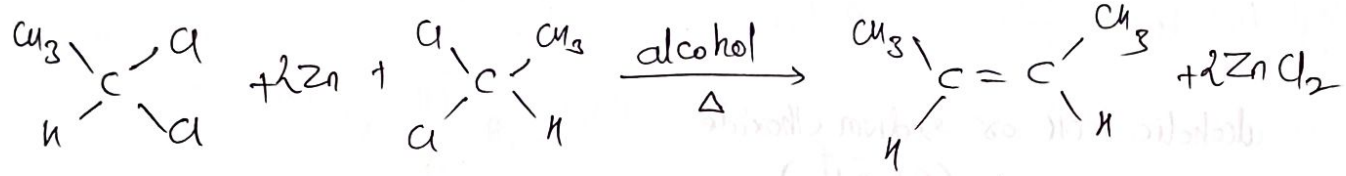
Vicinal dihalide + Zn $\xrightarrow[\Delta]{\text{alcohol}}$ Alkene

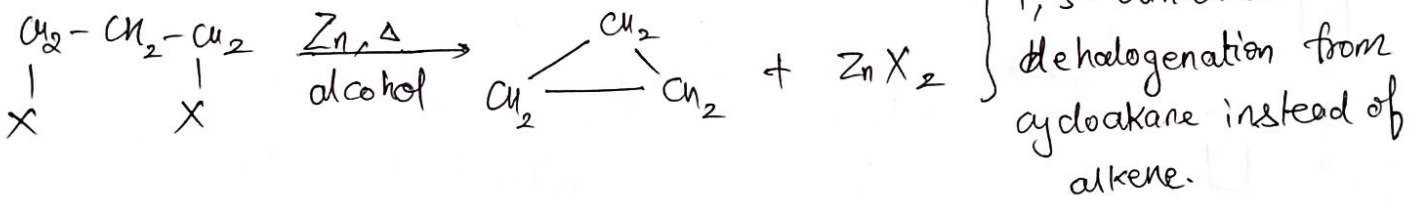
eg. $R-\underset{X}{\overset{X}{CH}}-CH_2 + Zn \xrightarrow[\Delta]{\text{alcohol}} R-CH=CH_2 + ZnX_2$

eg. 

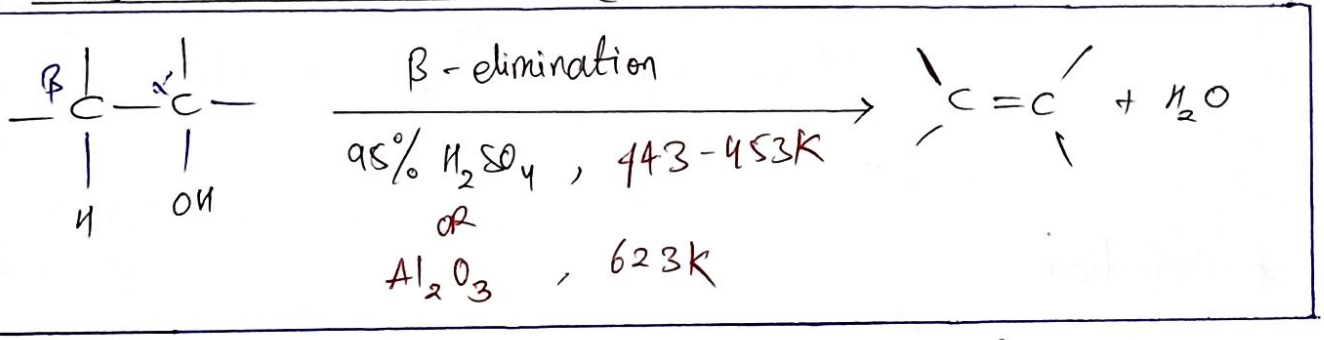
Geminal dihalide + Zn $\xrightarrow[\Delta]{\text{alcohol}}$ Alkene



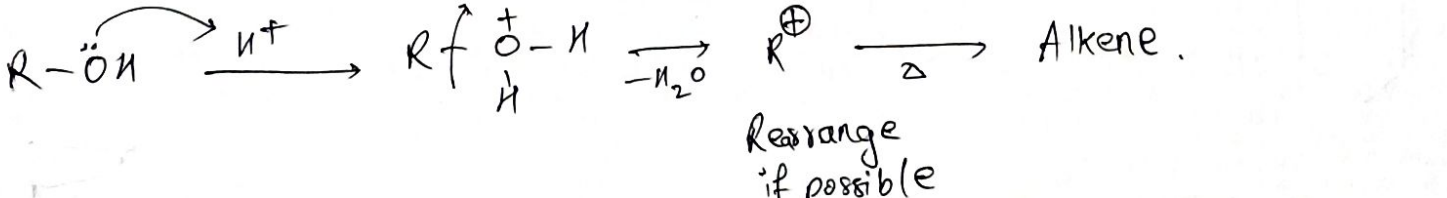
eg 

eg. 

(5) Dehydration of alcohols: (E^1 Mechanisms)



Ease of dehydration of alcohols: $3^\circ > 2^\circ > 1^\circ$



eg. $CH_3-CH_2-OH \xrightarrow[\Delta]{H^+} CH_3-\overset{\oplus}{C}H_2 \xrightarrow{\Delta} CH_2=CH_2$

eg Re arrangement

a) $H^\ominus$ shift

eg. $CH_3-CH_2-CH_2-OH \xrightarrow{H^+/\Delta} CH_3-\overset{1}{C}H_2-\overset{\oplus}{\underset{2}{C}}H_2 \xrightarrow[\text{shift}]{1,2\ H^\ominus} CH_3-\overset{\oplus}{C}H-CH_3 \xrightarrow{\Delta} CH_3-CH=CH_2$

$2^\circ H$ $\qquad$ $6^\circ H$

b) $Me^\ominus$ shift

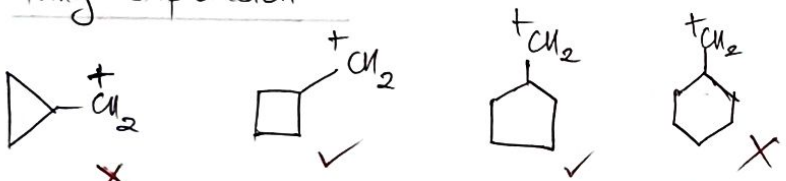
$$CH_3-\underset{CH_3}{\overset{CH_3}{\underset{|}{\overset{|}{C}}}}-CH_2-OH \xrightarrow{H^+/\Delta} CH_3-\underset{CH_3}{\overset{CH_3}{\underset{|}{\overset{|}{C}}}}-\overset{\oplus}{\underset{2}{C}}H_2 \xrightarrow[\text{shift}]{1,2\ Me^\ominus} CH_3-\underset{\oplus}{\overset{CH_3}{\overset{|}{C}}}-CH_2-CH_3 \xrightarrow{\Delta}$$

$$CH_3-\overset{CH_2}{\overset{\|}{C}}-CH_2-CH_3 \quad + \quad CH_3-\overset{CH_3}{\overset{|}{C}}=CH-CH_3$$

$5^\circ H$ $\qquad$ $9^\circ H$

(Minor) $\qquad$ (Major)

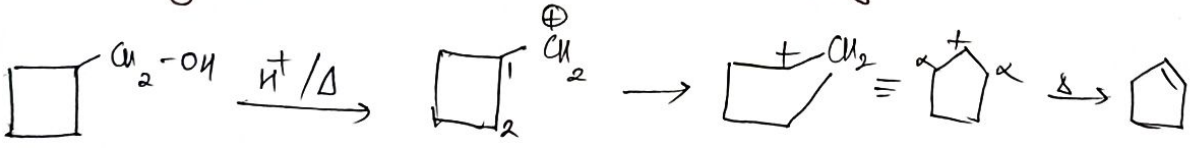
② Ring expansion



✗ $\qquad$ ✓ $\qquad$ ✓ $\qquad$ ✗

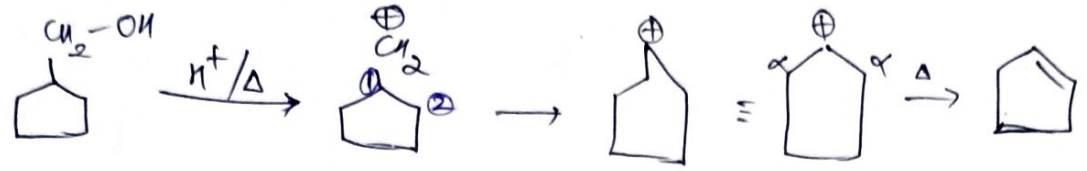
↳ No shifting
↳ No Ring expansion

↳ No Ring Exp.
↳ Shifting ✓

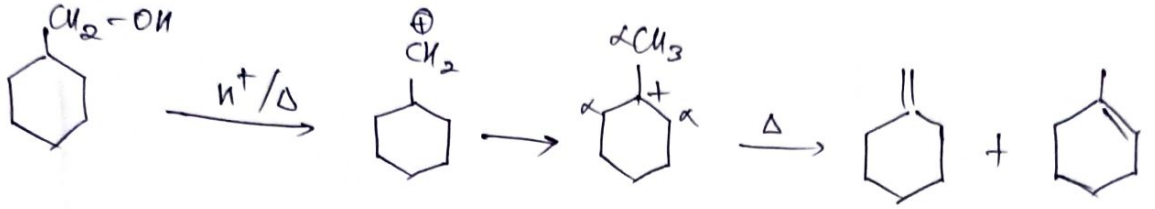
eg 

1,2 Bond ko
Thodo 2 ko ⊕
se Sodo.

Eg.



Eg.

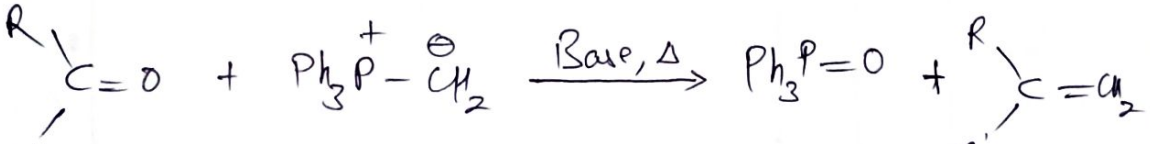


4∝H (Minor) 7∝H (Major)

⑥ By Electrolysis of salts of dicarboxylic acids (Kolbe's Reaction)

Potassium succinate

⑦ Wittig Reaction:

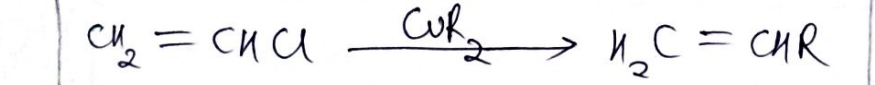


Aldehyde or ketone

Phosphorous ylide

Alkene

⑧ By action of dialkyl copper on vinyl halide:



Vinyl chloride

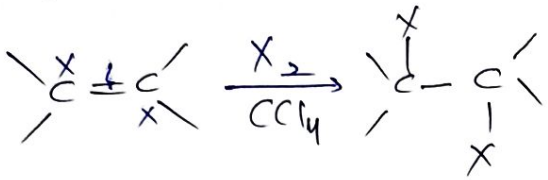
alkene

Chemical Properties of Alkene:

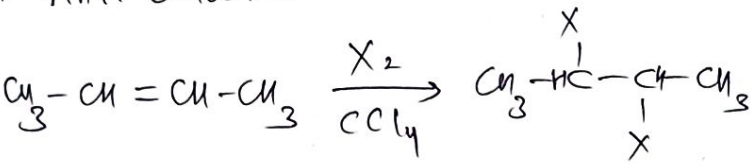
① Addition of Hydrogen ✓

② Addition of Halogen

a) In CCl_4

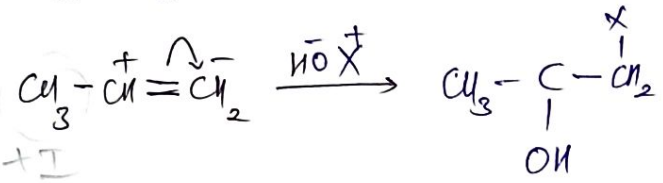


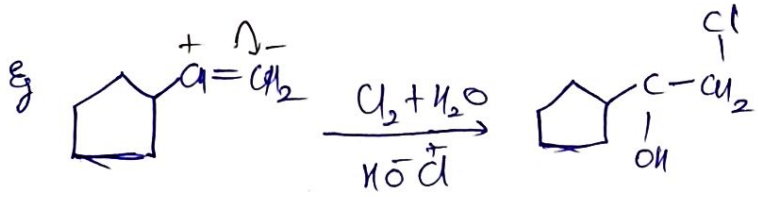
Anti addition



b) In H_2O

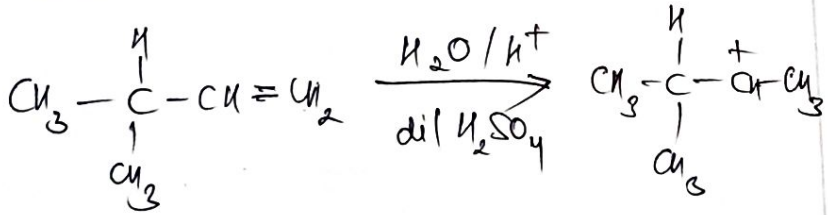
$$X_2 + H_2O \longrightarrow H\bar{O}\overset{+}{X}$$

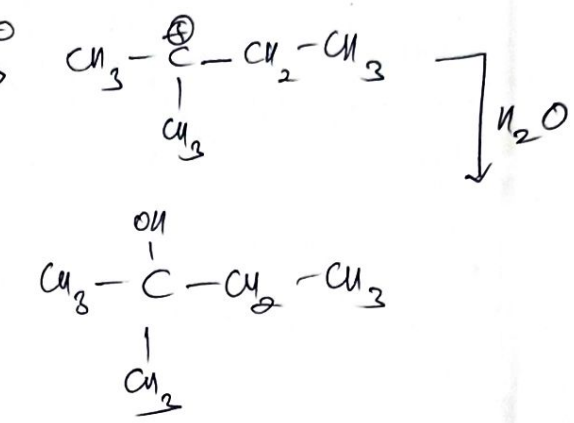
e.g. 

e.g. 

③ Addition of (HX) [Halogen acid] ✓

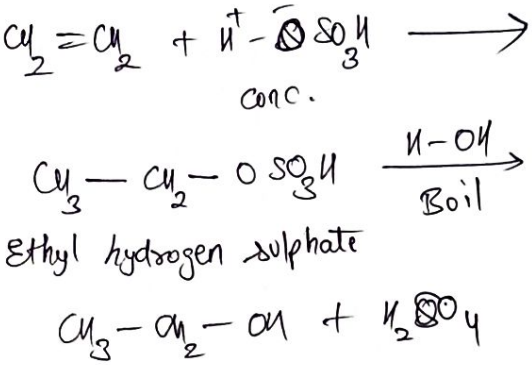
④ Addition of water (Hydration):





→ It follows Markownikoff's addition.

⑤ Addition of sulphuric acid:



(6) Addition of OH group (Hydroxylation)

syn addition

a) Bayer's Reagent [dil alkaline $KMnO_4$] / cold

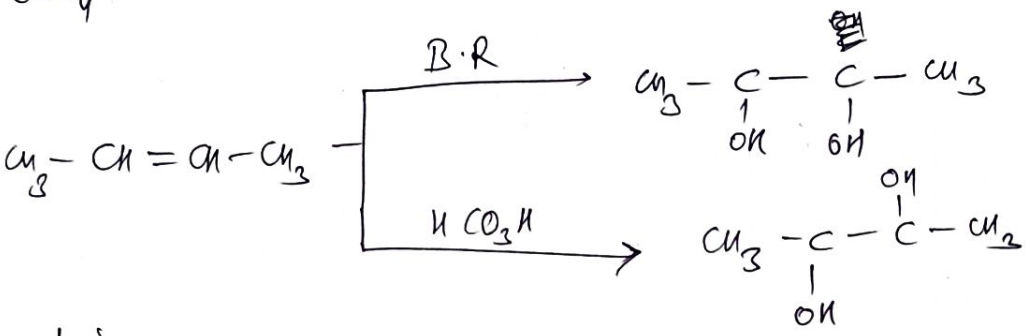
b) OsO_4

Anti addition

a) RCO_3H / H_2O

b) HCO_3H

e.g.



(7) Ozonolysis

Reductive

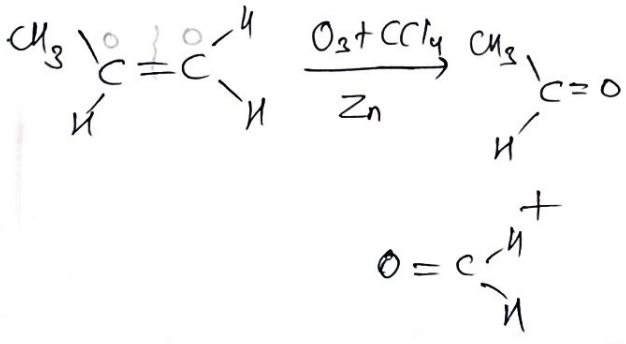
(R) → $O_3 + CCl_4 / Zn$

OR

$O_3 + CCl_4 / Zn + H_2O$

or

$O_2 + CCl_4 / Me_2S$



oxidative

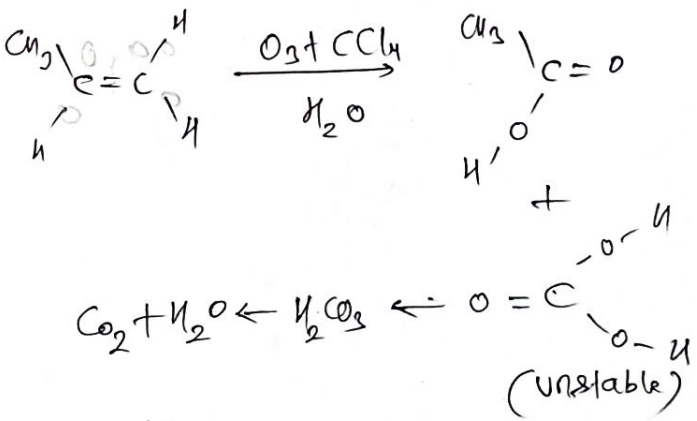
(R) → $O_3 + CCl_4 / H_2O$

or

$O_3 + CCl_4 / H_2O_2$

or

$KMnO_4 / H^+$ or $KMnO_4 / \Delta$



6) Oxidation Reactions

1) Combostion: $C_nH_{2n} + \frac{3n}{2}O_2 \longrightarrow nCO_2 + nH_2O$; $\Delta H = -ve$

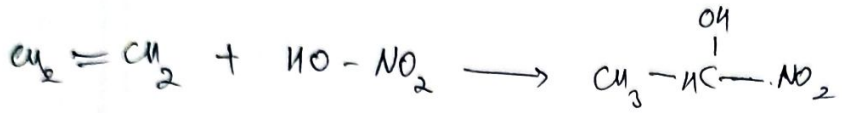
2) Hydroboration - oxidation ✓

3) Catalytic oxidation / Epoxidation :

$CH_3 - CH = CH_2 + \frac{1}{2}O_2 \xrightarrow[520-523\,K]{Ag}$ 

Epoxy propane

g. Addition of Nitric acid : Nitric acids adds to alkenes to form nitroalcohols;



1-Nitroethanol

h. Addition of Acetyl chloride : Acetyl chloride adds to alkenes to form chloro ketones.

4-chlorobutan-2-one

$\Delta H_{Hyd} \propto \frac{1}{\text{stability of alkene}}$

ΔH → Heat of Hydrogenation

Aromatic Compound Burns with sooty flame.