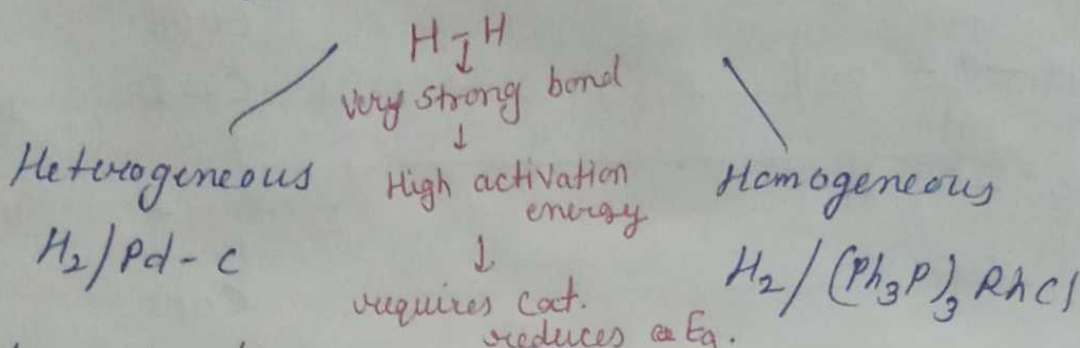
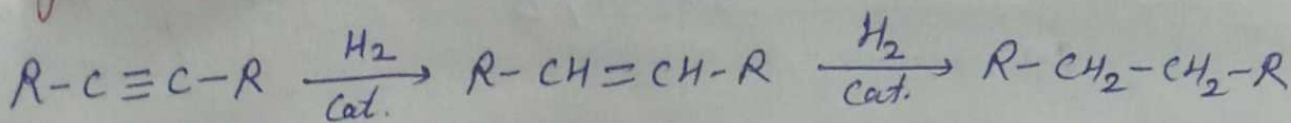
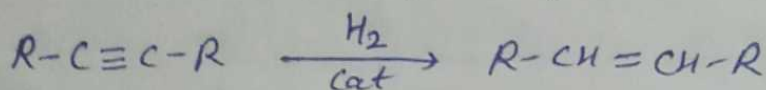


# Reduction of Alkynes

Catalytic Hydrogenation: Alkyne  $\rightarrow$  Alkene  $\rightarrow$  Alkane

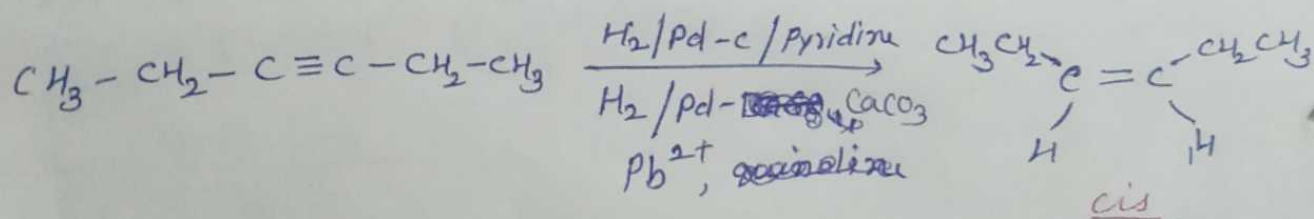


Partial reduction of alkynes: Lindlar's catalyst



\* Lindlar's catalyst :- Pd poisoned with  $Pb^{+2}$  and an amine (quinoline or pyridine)

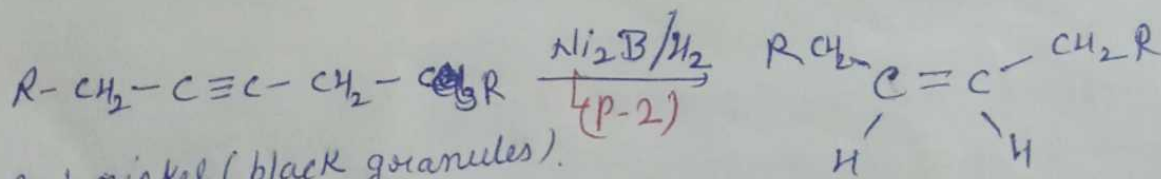
- This catalyst is ineffective for alkenes.
- Non-terminal alkynes convert into cis-alkenes.



• stereoselective reaction. chemical composition  $Ni_{2.5}B$

\* Nickel boride ( $Ni_2B$ ):-  $NiSO_4 + NaBH_4$

- conversion of alkynes into cis-alkene



$Ni \begin{cases} P-1 \text{ nickel (black granules)} \\ P-2 \text{ nickel (colloidal suspensions)} \end{cases}$

P-1 = insensitive to steric hindrance thus more active! - complete reduction

P-2 = sensitive to " " " less active - partial reduction

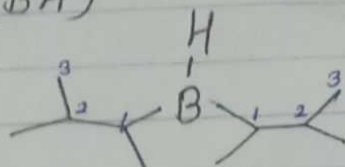
## 2) Reduction with borane (Hydroboration of alkynes) (5)

- A sterically hindered dialkyl borane

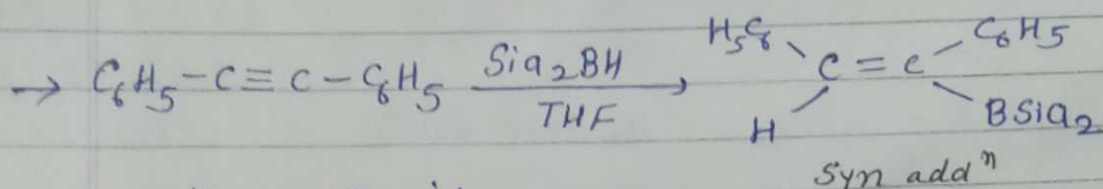
(Disiamyl borane:  $\text{Si}a_2\text{BH}$ )

↳ Sec. Iso amyl

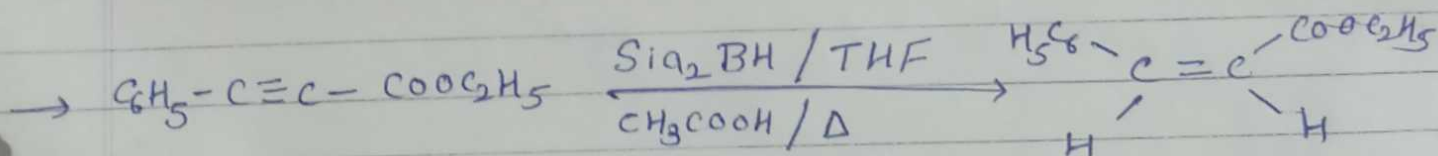
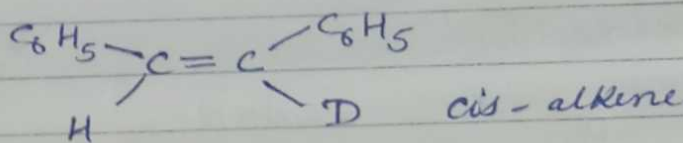
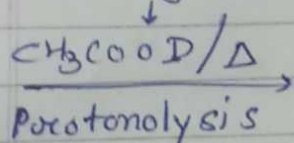
↓  
1,2-dimethyl propyl



- Stereoselective, and syn addition
- inert towards  $\text{NO}_2$ ,  $\text{COOR}$ , halo groups.



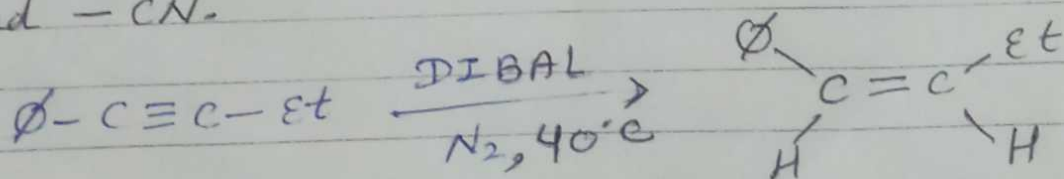
Boiling acetic acid



★ DIBAL diisobutyl aluminium hydride

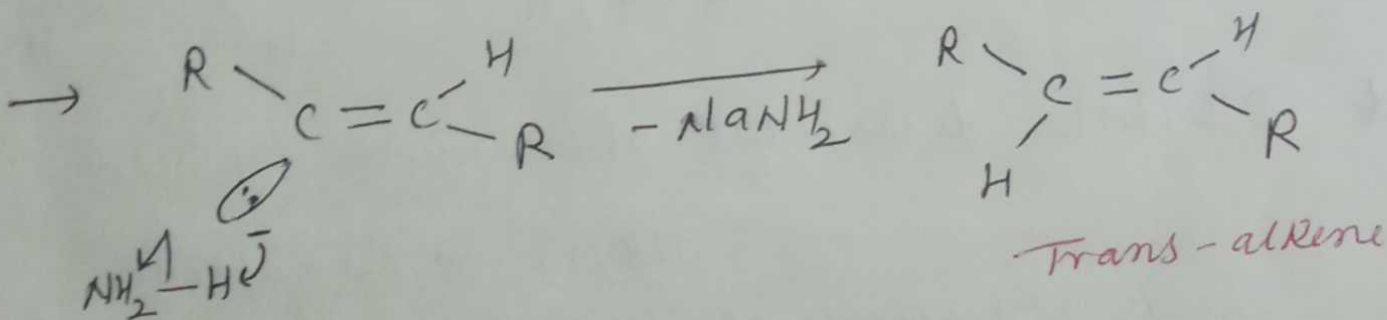
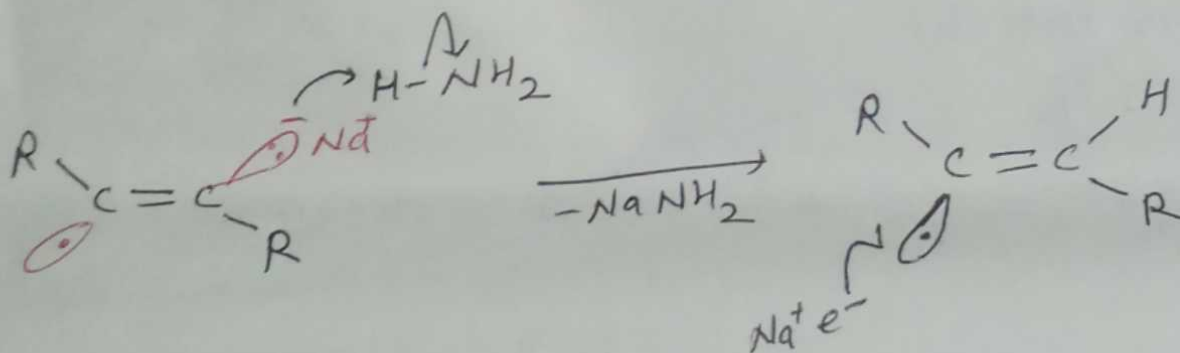
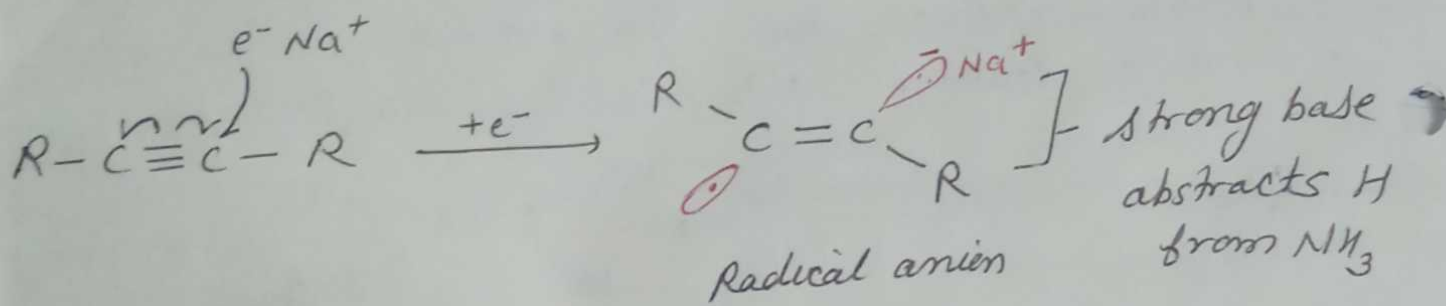
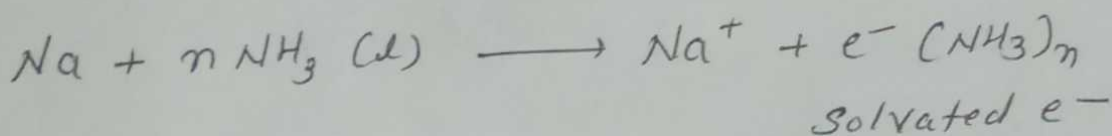
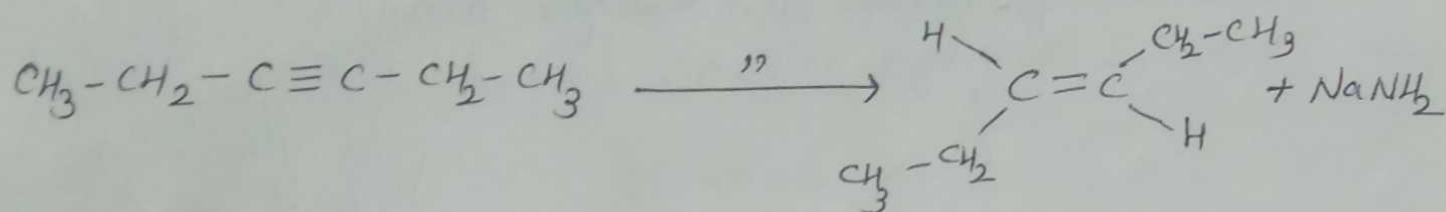
↓  
alkyne  $\rightarrow$  cis-alkene

- inert atmosphere at  $40^\circ\text{C}$
- selective  $\text{bzoz}$  inert ~~to~~ towards most of the functional groups except  $-\text{C}\equiv\text{C}$ ,  $-\text{COOR}$  and  $-\text{CN}$ .



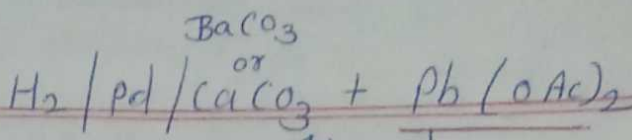
### 3. Reduction with IA metals in liquid $\text{NH}_3$

• Non-terminal alkyne  $\xrightarrow{\text{Na}/\text{NH}_3(l)}$  Trans alkene





# Lindlar catalyst



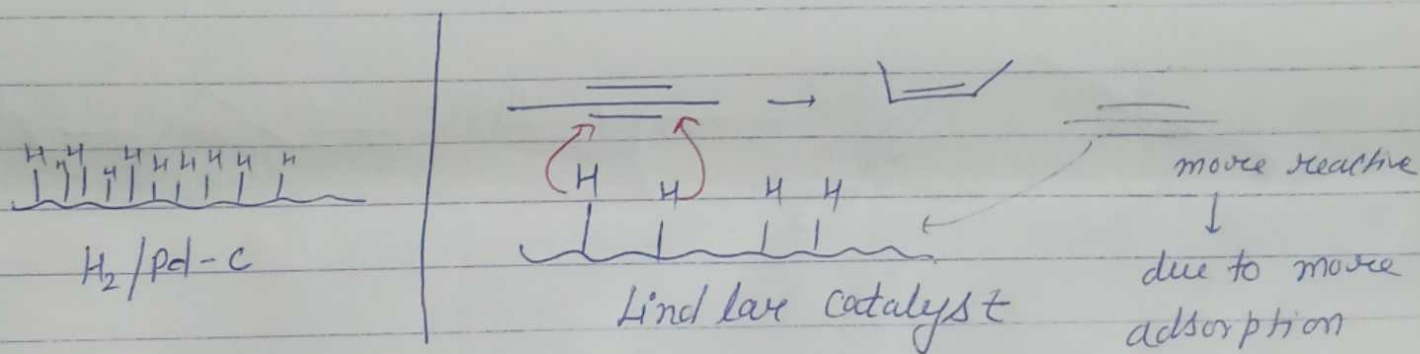
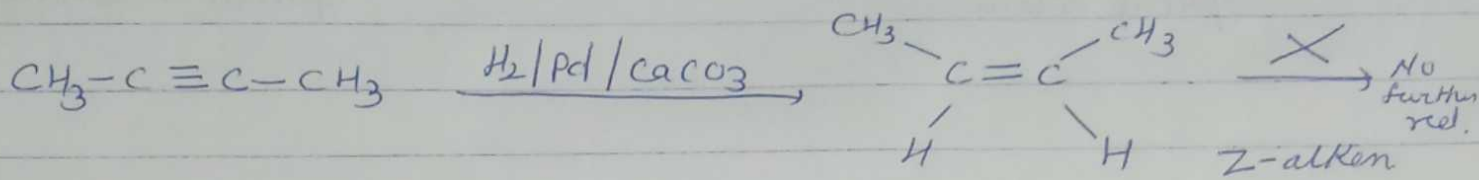
$CaCO_3 \rightarrow$  provides surface

- $\hookrightarrow$  Pd is adsorbed in form of powder,
- $\hookrightarrow$  H is adsorbed

deactivates  $\downarrow$   
deactivating the activity of Pd

main properties :-

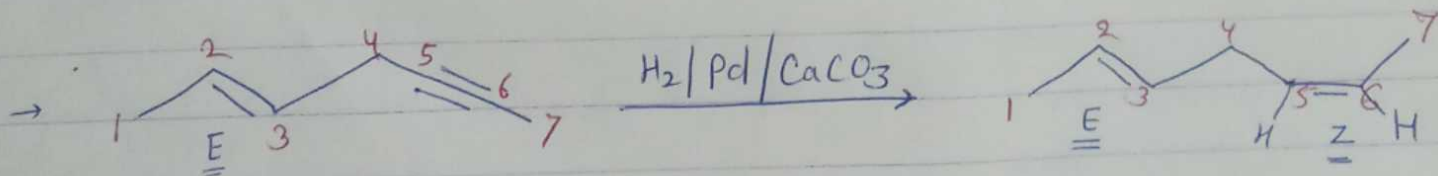
- Syn addition
- Controlled reduction of alkyne to alkene
- Formation of Z-alkene
- Selective reduction of alkyne in presence of alkene



adsorption  $\rightarrow$   $\pi$ -complex के कारण होता है

needs to collide in proper orientation.  
alkene

collide करते ही adsorb हो जाते हैं।  
alkyne




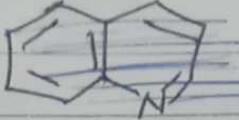
Lindlar catalyst is a heterogeneous catalyst <sup>(6)</sup> that consists of Palladium deposited on ~~Na<sub>2</sub>SO<sub>4</sub>~~ <sup>CaCO<sub>3</sub></sup> which is ~~poised~~ poisoned with lead.

Named after Herbert Lindlar

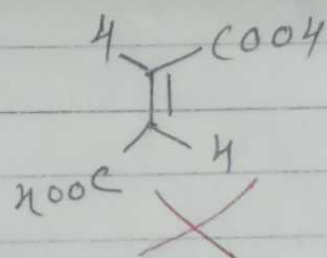
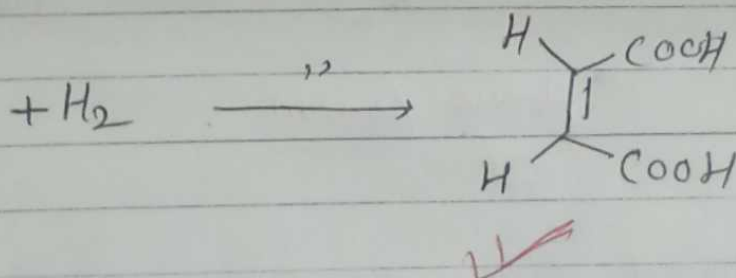
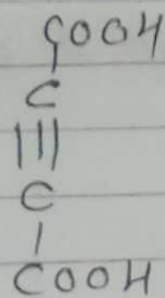
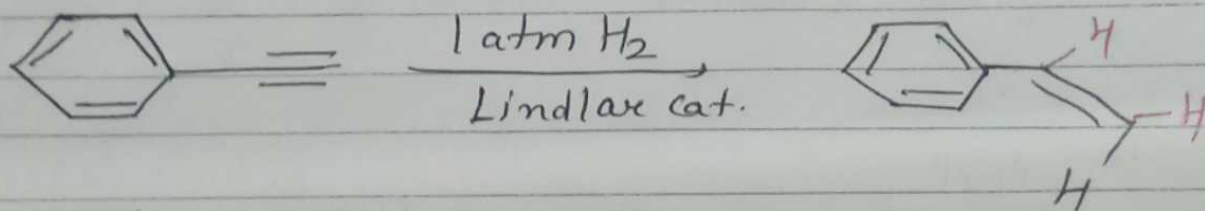
5% Pd - ~~Base~~ CaCO<sub>3</sub>

Pd/CaCO<sub>3</sub>  
Pb(OAc)<sub>2</sub>  
OR

Pb(OAc)<sub>2</sub> lead acetate

Pd/BaSO<sub>4</sub> in quinoline   quinoline

Lead → deactivate the palladium sites



acetylenedicarboxylic acid

Maleic acid ✓

fumaric acid ✗

