

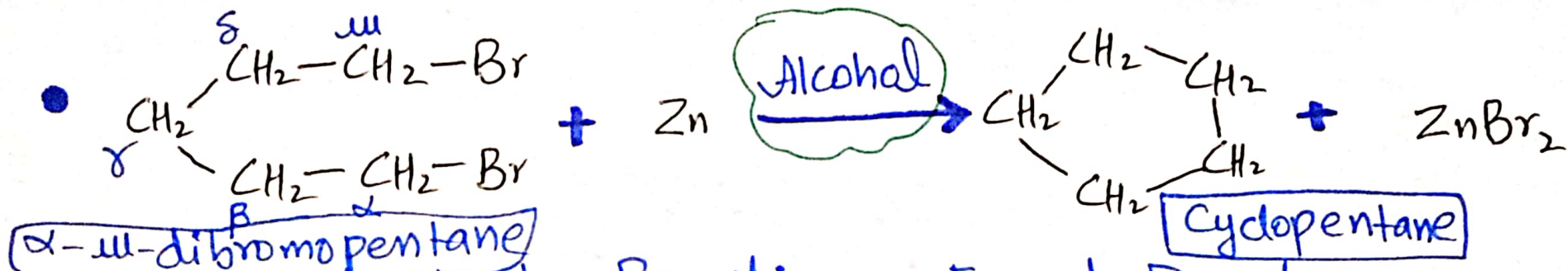
CYCLOALKANE

- Aliphatic saturated hydrocarbs, sp^3 hybridized C atoms arranged in rings.
- All C atoms have tetrahedral geometry except for cyclopropane (\triangle) and cyclobutane (\square)
- General formula = C_nH_{2n} for 1 ring.
 C_nH_{2n-2} for 2 rings
 C_nH_{2n-4} for 3 rings

PREPARATION METHODS:

- Petroleum — cycloalkanes particularly 5 or 6-membered
 - Naphthenes: Name of cycloalkanes in petroleum industry -
1. From α, ω dihalides: (Dehalogenation)





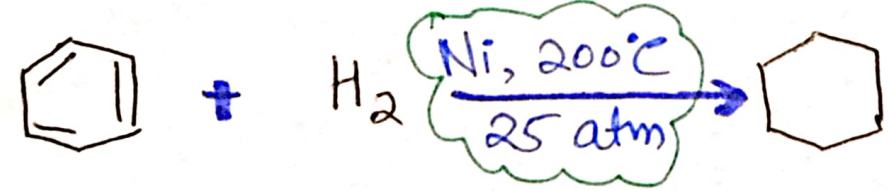
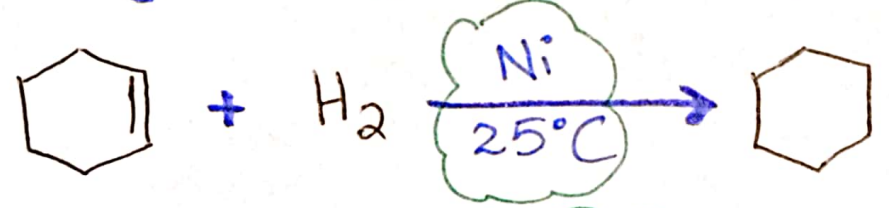
- Modified Wurtz Reaction = Freud Reaction

- Reagent** :- Na or Zn dust in warm alcohol.

- Difficult to prepare rings larger than 7-membered

- Method used for industrial preparation of Δ from 1,3-dichloropropane (by-product in chlorination of propane)

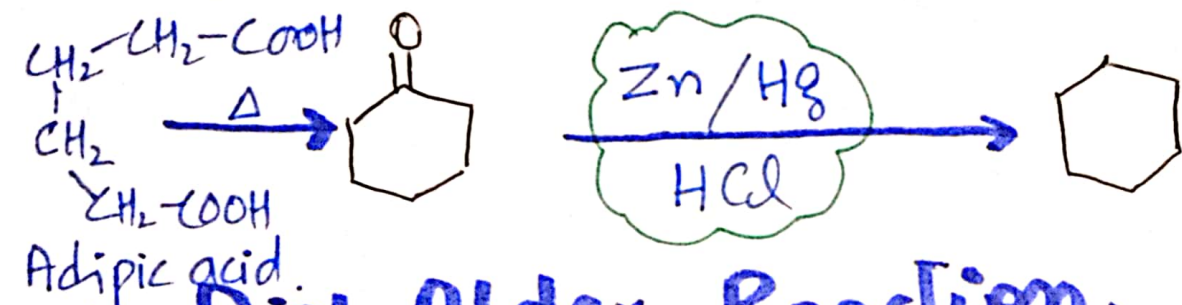
2. Catalytic hydrogenation of cycloalkene:



3. Reduction of cycloketones:

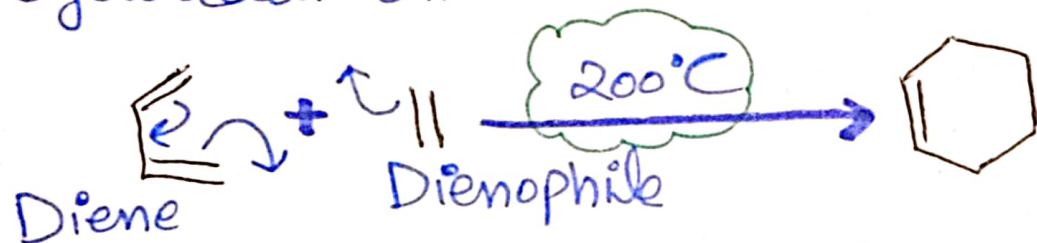
● Clemmenson Reduction

Cycloketone can be prepared by craking of dicarboxylic acid



4. Diel Alder Reaction:

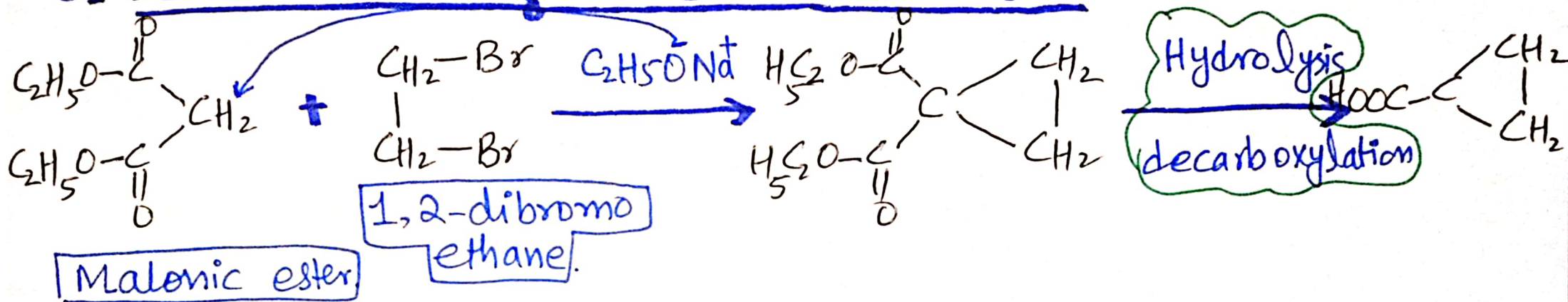
● Cycloaddition reaction - stereospecific reaction



5. Simmons-Smith Reaction: (Alkene + CH_2I_2 + Zn-Cu couple)



6. Perkin's Ring closure Reaction:



- Cycloalkanes with 3, 4, 5 and 6-membered rings can be prepared.

PHYSICAL PROPERTIES:

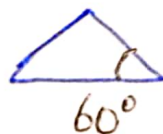
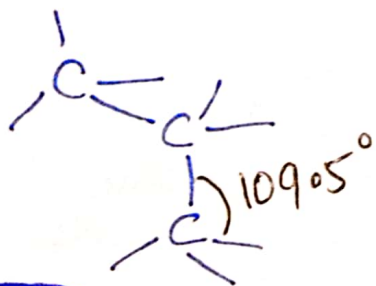
- Cyclopropane and Cyclobutane \rightarrow Gases.
- High M.P° and B.P° \rightarrow due to greater symmetry (tight packing)
- Soluble in non-polar solvents.
- Density = less than 1 g/cm³.

Classification:

1. Small rings — Small angle strain Δ, \square
2. Common rings — unstrained (5, 6, 7-membered)
3. Medium ring — considerable strain (8-11-membered)
4. Large rings — No strain. (12-membered)

Bayert's strain theory:

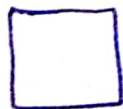
• explains structure and stability of cycloalkanes



$$\frac{109.5^\circ - 60^\circ}{2} = \boxed{24.75^\circ}$$

Angle Strain

More strain
Less stability

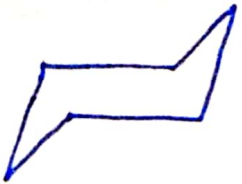



$$\frac{109.5 - 90}{2} = \boxed{9.75}$$

Angle Strain

Drawback:

It considers molecule planar

•  chair-form — less angle strain — less flagpole interactions — more stable.

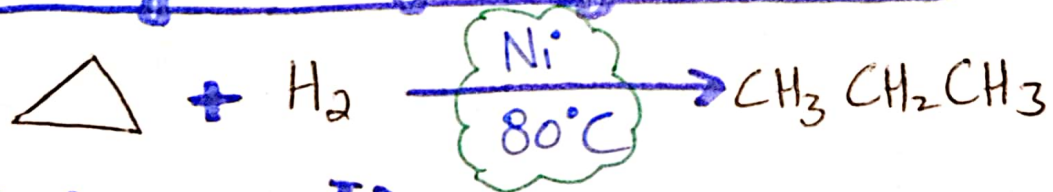
•  Boat-form — flagpole interactions — less stable than chair conformation

CHEMICAL REACTIONS:

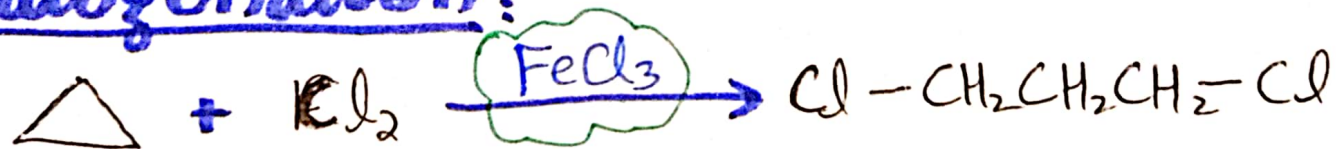
• Cyclopropane and cyclobutane give ring opening reacts readily

1. Addition Reaction:

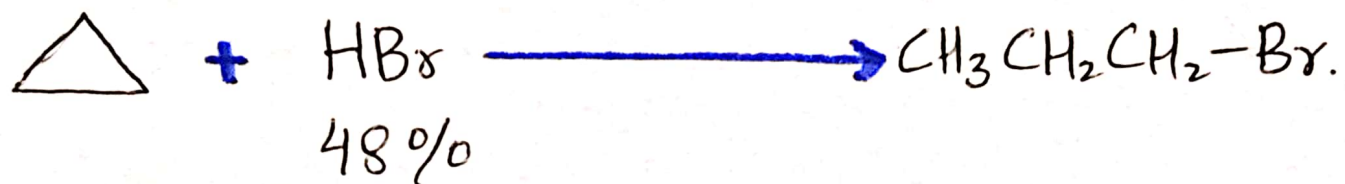
A. Catalytic Hydrogenation:



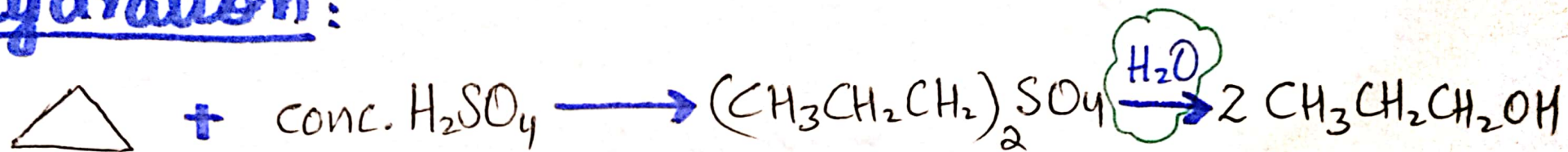
B. Halogenation:



C. Addition of HX:



D. Hydration:



- Cyclopropane and cyclobutane are less reactive than alkene.
- Cyclopentane and cycloalkane do not undergo ring-opening reactions easily. ^{higher}

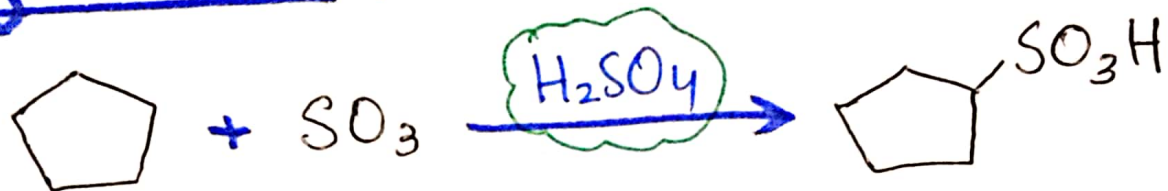
2. Substitution Reaction:

A. Halogenation:

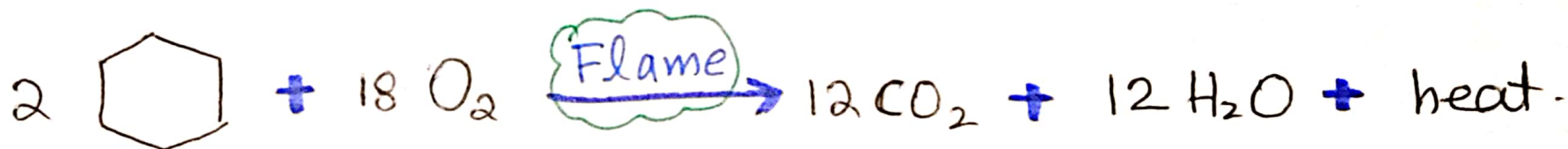
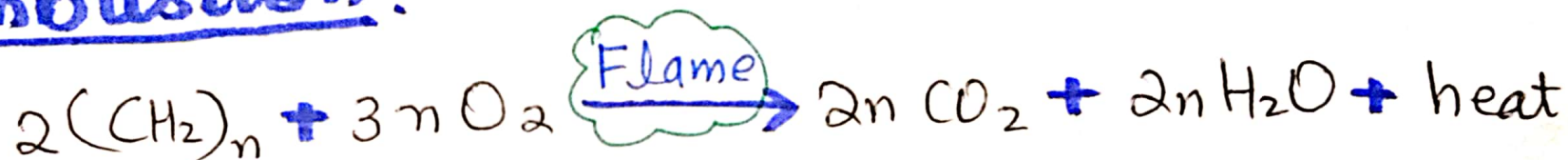


- fewer possible isomeric substitution products possible.

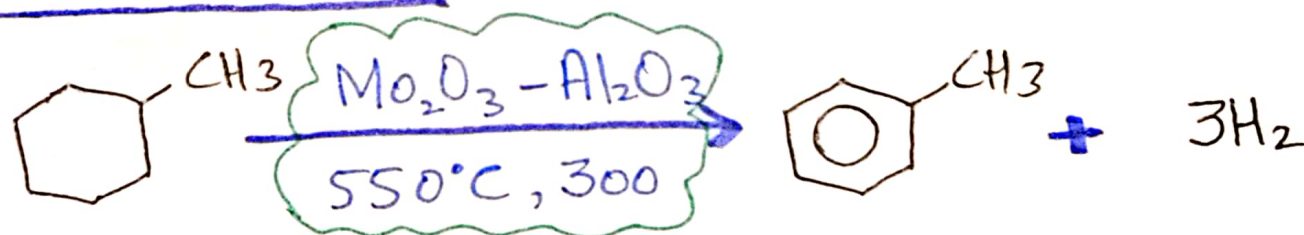
B. Sulfonation:



3. Combustion:



4. Aromatization:



5. Isomerization:

