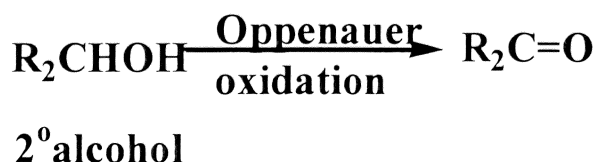
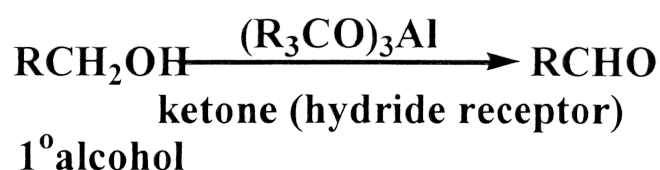


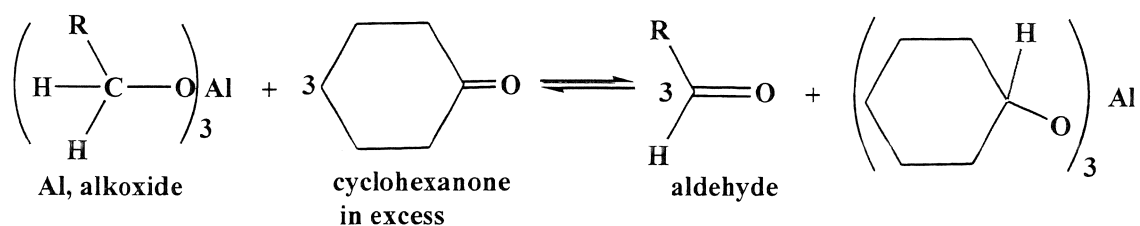
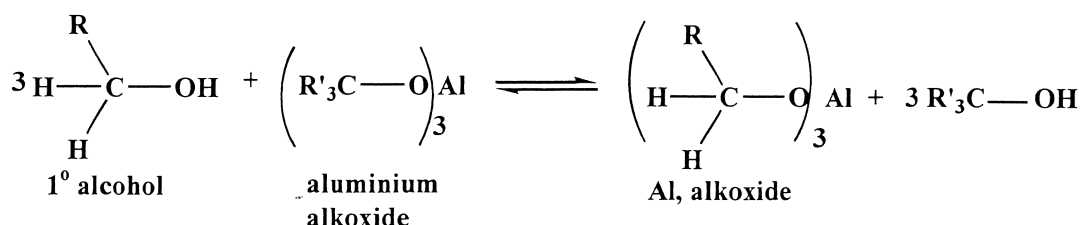
Oppenauer oxidation

- Aluminium t- butoxide $[(CH_3)_3CO]_3Al$ in the presence of a ketone (such as cyclohexanone) as an hydride acceptor, oxidizes primary alcohols to aldehydes, and secondary alcohols to ketones.
- hydride receptor is used in excess to push the equilibrium to the right side.
- Other functions (as alkene..) are not affected.



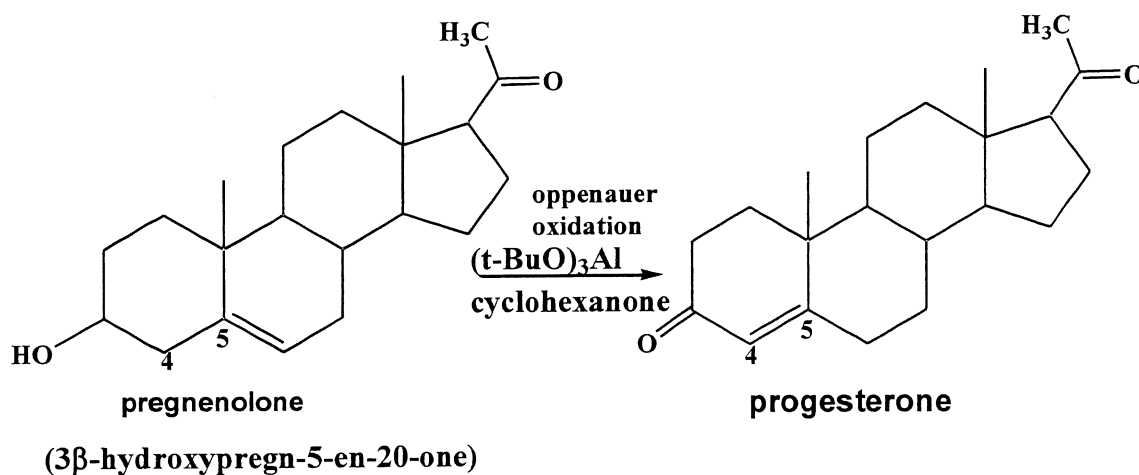
Oppenauer reaction mechanism

- Al- alkoxide transfers H^- to cyclohexanone (hydride acceptor).



Oppenauer oxidation (semi-synthesis of Progesterone from pregnenolone)

Oxidation of secondary OH to ketone with the simultaneous shifting of the double bond from C₅ to C₄ forming stable conjugated enone.



Drug Synthesis

الاصطناع (التخليق) الدوائي

Some types of reactions used in drug synthesis

5. Reduction reactions

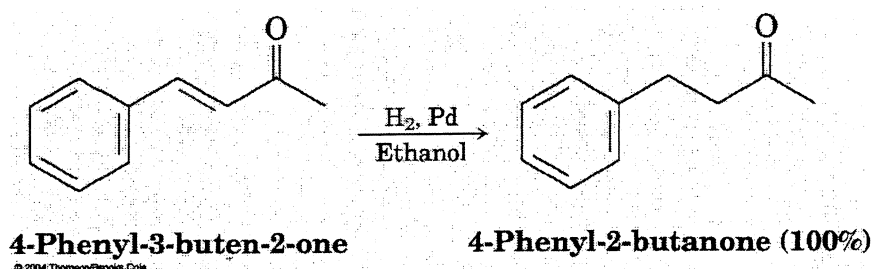
Types of Reduction Reactions

- . Reductive processes are divided into three categories:
- Addition of molecular hydrogen H_2 to the unsaturated systems (Catalytic hydrogenation of the unsaturated systems)
- Addition of hydrides H^- to the unsaturated systems (hydride reduction)
- Gain of electrons (Electron transfer reduction)

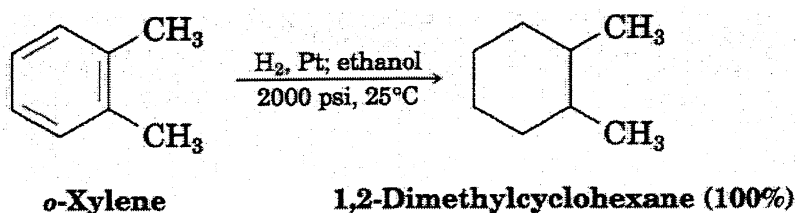
Catalytic hydrogenation

Selective catalytic hydrogenation of alkenes

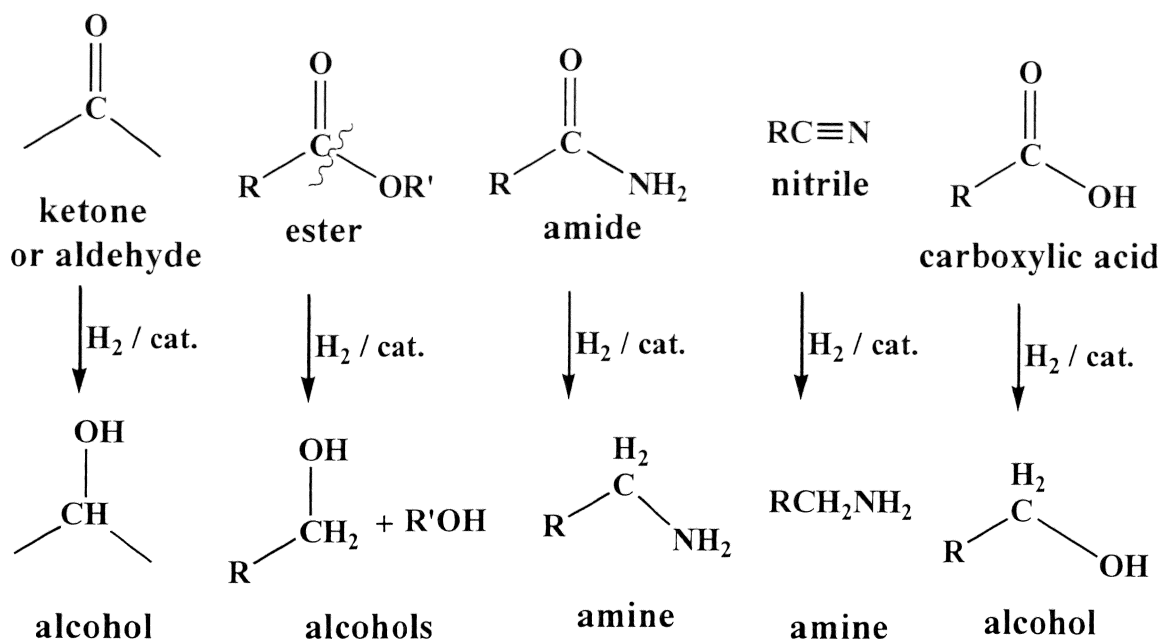
- Alkenes are easily and selectively reduced by $\text{H}_2/\text{Pd-C}$ reduces in the presence of other functions: aldehydes, ketones, esters, nitriles, carboxylic acid.



- The aromatic ring requires more powerful reducing conditions such as Pt at high pressure or rhodium Rd catalysts ordinary conditions

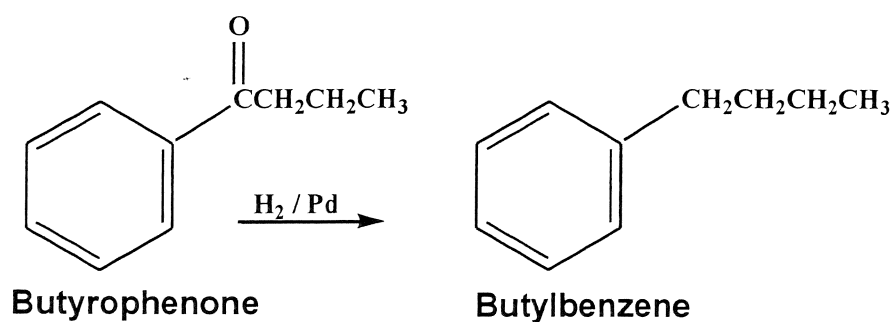


Catalytic reduction of functional groups (H_2 / cat.)



Catalytic Reduction of Alkyl aryl ketones

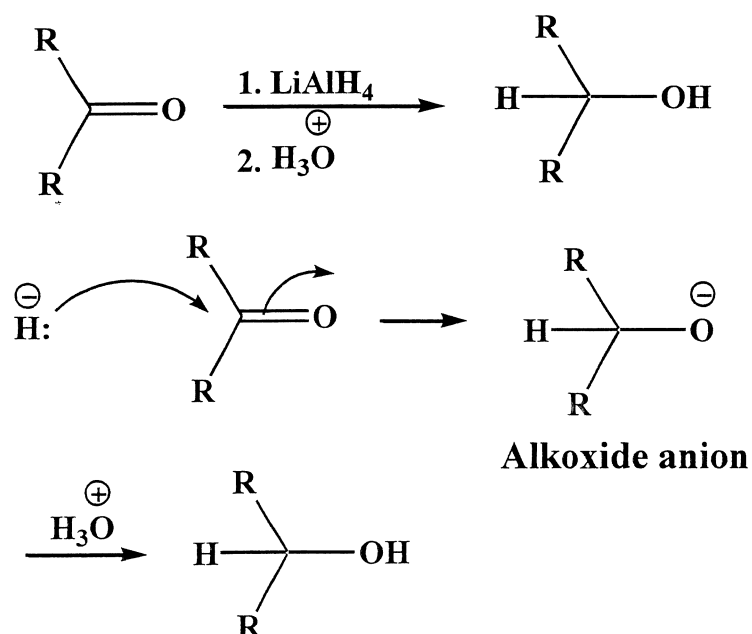
- Carbonyl function conjugated with aromatic ring (alkyl aryl ketones) is easily reduced to CH_2 by H_2/Pd , as in the reduction of alkenes



Reduction by hydrides

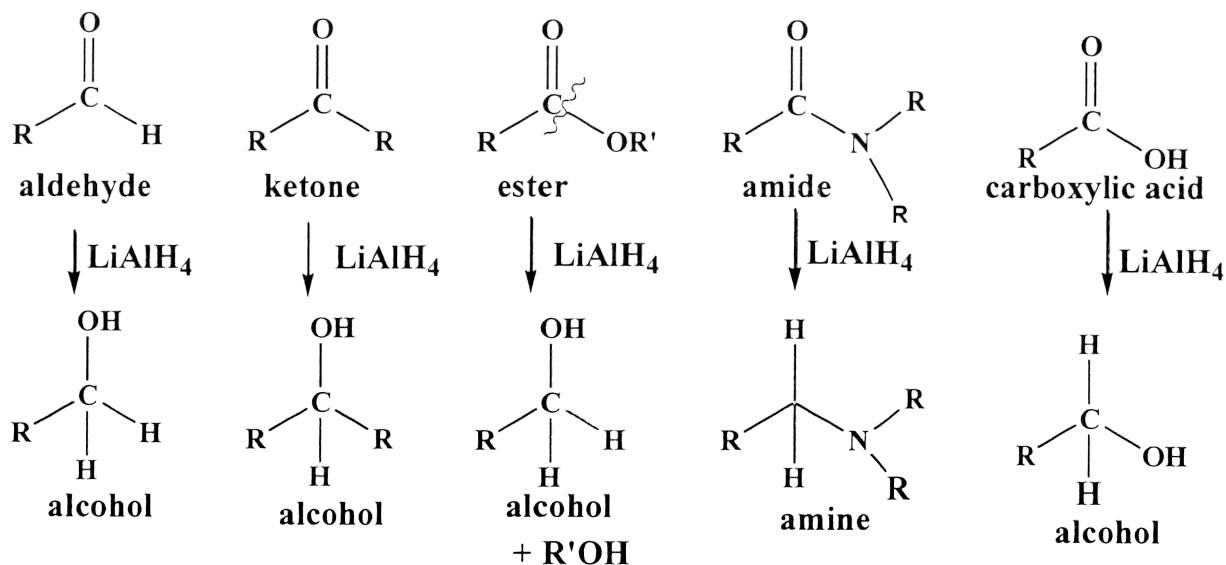
Mechanism of Reduction by hydrides

- Hydrides, as LiAlH_4 , NaBH_4 are chemicals that donate H^-
- Example: the reduction of the carbonyl group by LiAlH_4



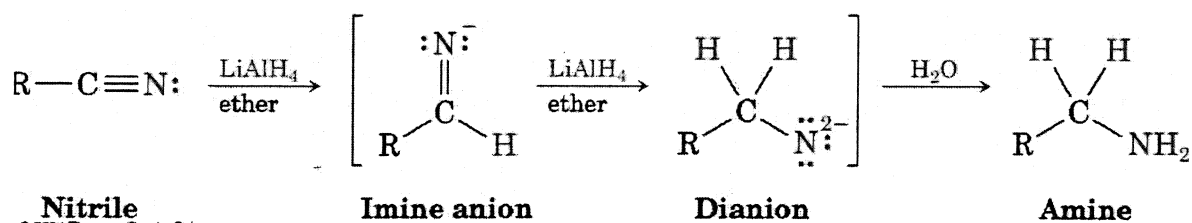
Reduction of functional groups by LiAlH_4

- Aldehydes, ketones, esters, amides and carboxylic acids are reduced by LiAlH_4 to alcohols except the amides which give amines.



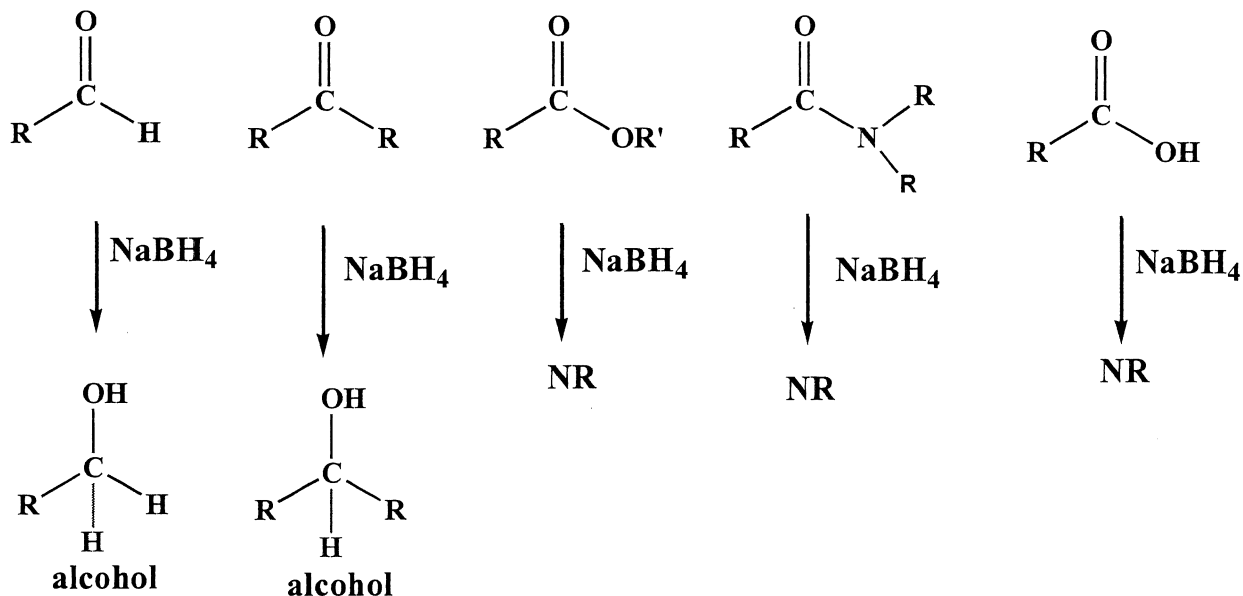
Reduction of nitriles by LiAlH_4

- Nitriles give primary amines



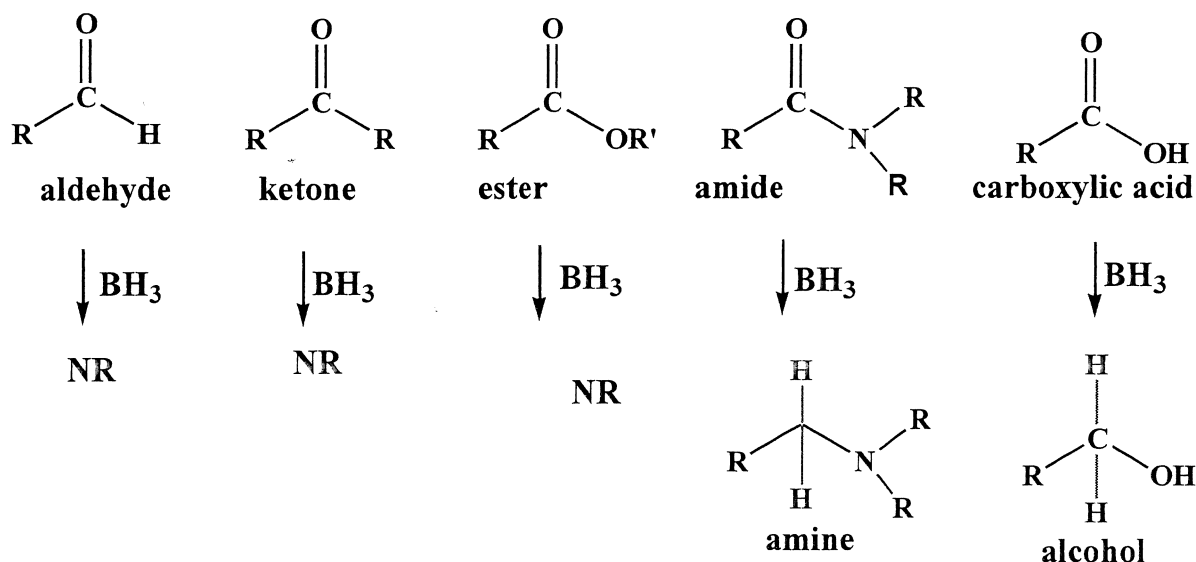
Reduction of functional groups by NaBH_4

- NaBH_4 only reduces aldehydes and ketones.
- Esters, amides, carboxylic acids and nitro (NO_2) are not affected by NaBH_4 .



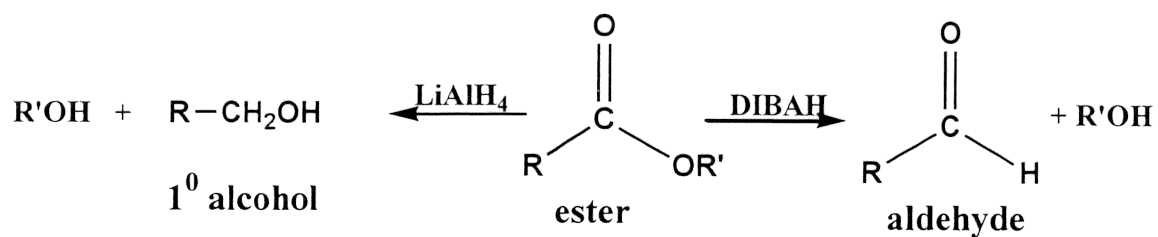
Selective reduction of carboxylic acid and amides by BH_3

- BH_3 reduces amides and carboxylic acids selectively.
- Esters, ketones, aldehydes and NO_2 are not affected by BH_3 .



Reduction of esters to aldehydes by DIBALH

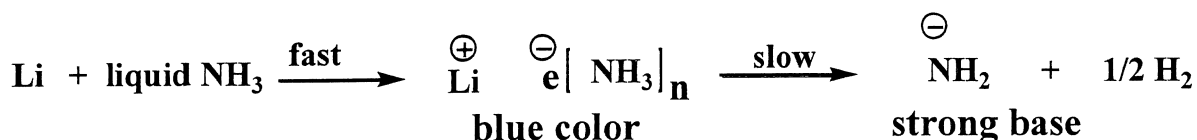
- Diisobutyl aluminium hydride (DIBALH) reduces esters and has no action on aldehydes



Electron transfer reduction

Reduction by transfer of electrons

- When metals such as sodium or lithium are dissolved in solvents such as liquid ammonia, they readily give up their single outer-shell electron and an intense blue solution of solvated electrons is formed .

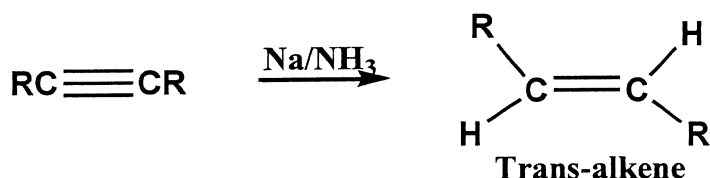


electrons solvated by ammonia

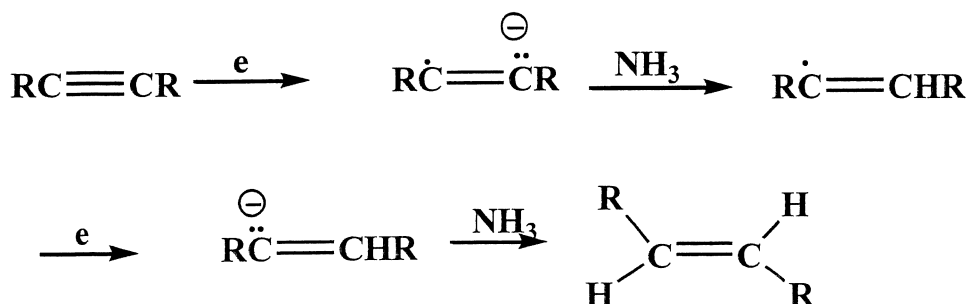
- With the time, the blue color fades as the electrons reduce the ammonia to amide ion NH_2^- and H_2 gas

Mechanism of Electron transfer reduction (Reduction of alkynes)

- Alkynes give trans alkenes (anti addition):

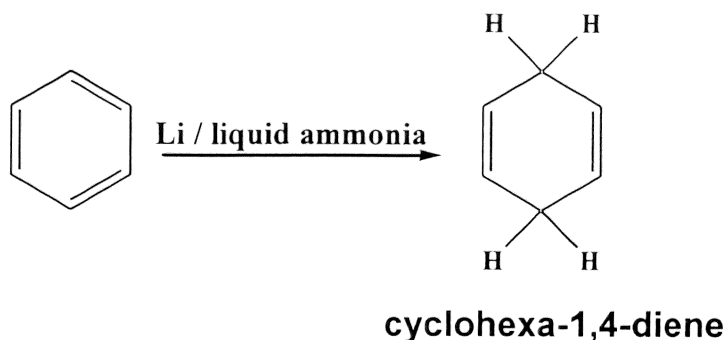


Mechanism



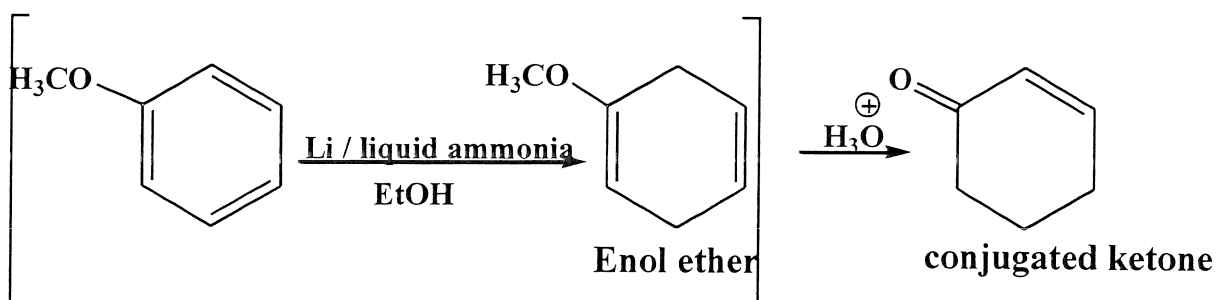
Electron transfer reduction (Reduction of benzene: Birch reduction)

This reaction performs 1,4-protonation with the formation of cyclohexa-1,4-diene

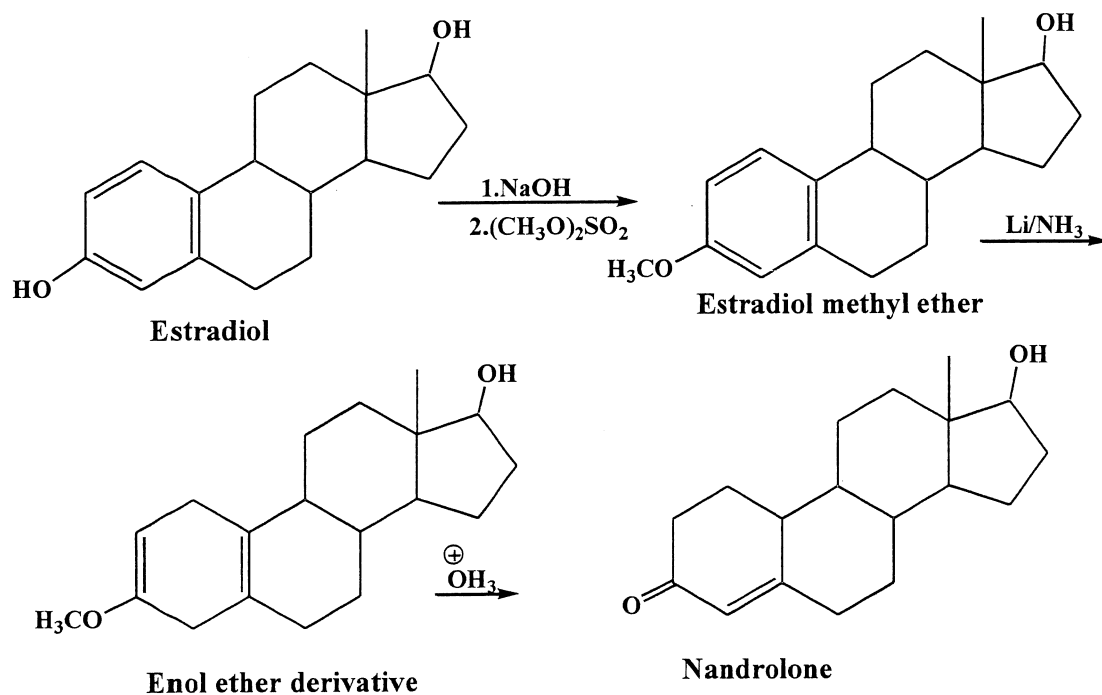


Birch reduction of methoxybenzene

- When EDG such as OCH_3 is present, protonation takes place at ortho and meta and 1-methoxycyclohexa-1,4-diene is formed.
- Ethanol is added to serve as a better proton donor than NH_3 .
- Acid hydrolysis of the enol ether product gives unsaturated ketone which tautomerises to the conjugated ketone (conjugated enone)



Synthesis of the anabolic Nandrolone



Hydrogenolysis