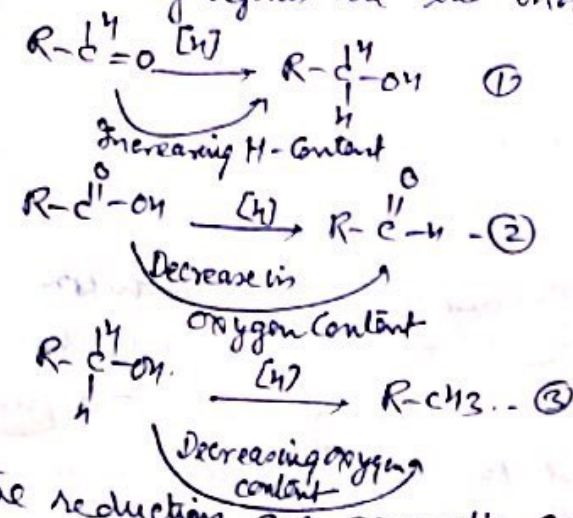
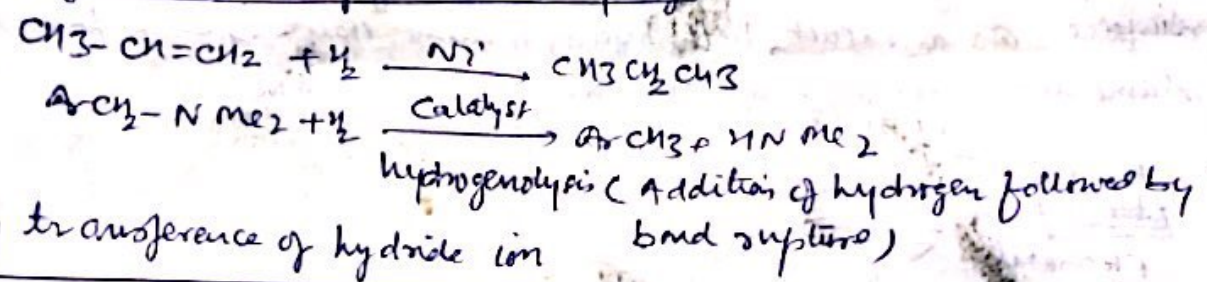


An increase in hydrogen content or a decrease in oxygen content, is known as Reduction. When an organic compound is reduced, the reducing agent is oxidised and vice versa. Most of the oxidising or reducing agents are the inorganic compounds.



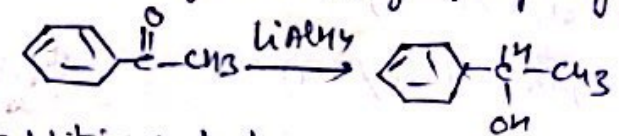
The reductions are generally carried out either by catalytic hydrogenation or chemically. Three important pathways of reduction includes-

① Catalyzed addition of molecular hydrogen:



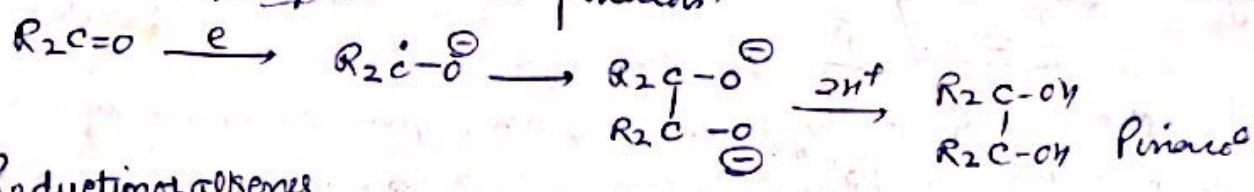
② By transference of hydride ion

eg. reduction of a carbonyl group by LiAlH₄



③ By addition of electrons followed by uptake of protons

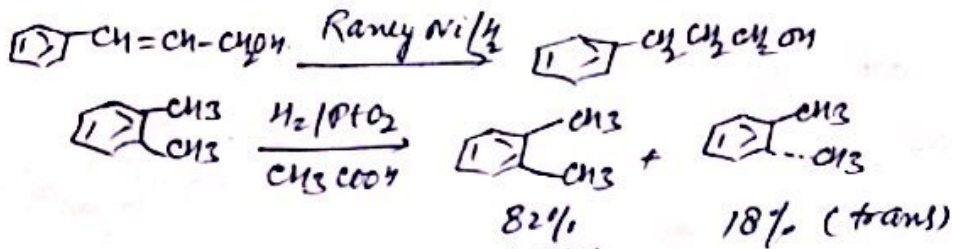
eg. reduction of anisole by liq. NH₃ containing ethanol or reduction of ketones to pinacols.



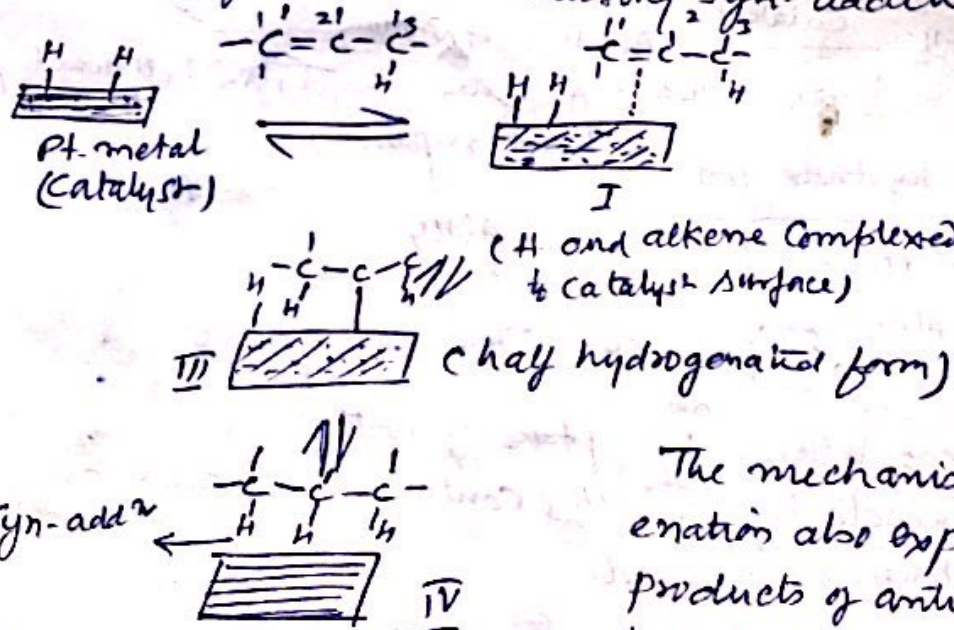
Reduction of alkenes

Hydrogenation of alkenes, is an exothermic reaction. The redⁿ of any an alkene does not take place at room temp, without a catalyst but often occurs in presence of a metal catalyst. Most commonly used catalysts are Ni, Pt, Pd etc.

Redn of C=C is easiest and occurs readily under mild conditions. Raney Ni is also used in some cases, choice of the reducing agent depends on the nature of the other reducible groups, present in the alkene. Pt is used for more exhaustive redn.

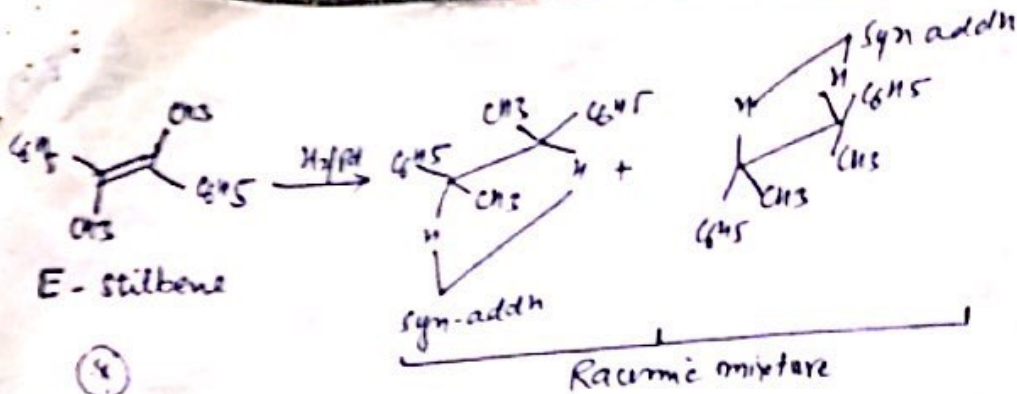


Process of hydrogenation is thought to proceed via a mechanism involving adsorption of hydrogen molecule on the surface of the catalyst. The unpaired electrons on the surface of the metal, pair with the electrons of hydrogen to bind the hydrogen to the surface. The surface bearing adsorbed hydrogen causes adsorption of the alkene and a subsequent step wise transfer of hydrogen occurs. This process yields an alkane before the organic molecule leaves the surface. As a result, both hydrogen atoms usually add from the same side of the molecule causing syn-addition.



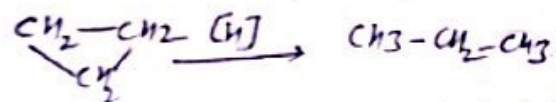
The mechanism of catalytic hydrogenation also explains, the unexpected products of anti-addition during some hydrogenations.

Stereochemically the hydrogenation of an olefin occurs in syn-manner. When we consider hydrogenation of E-stilbene, the syn-addition gives the meso-isomer, while the syn-addition to the Z-isomer gives the meso-isomer.

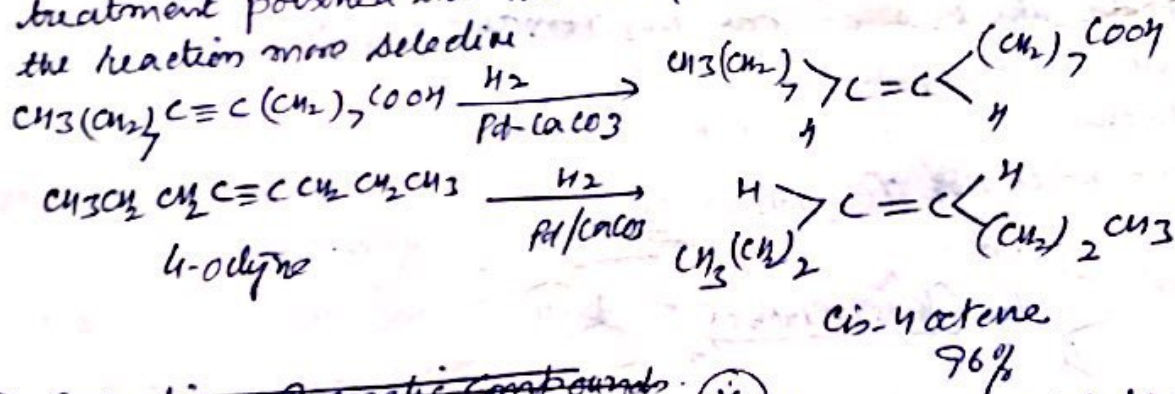


② Reduction of alkanes

Alkanes which are strained can be reduced catalytically by rupturing C-C bonds. The C-C cleavage relieves the strain. Normally all olefins can be reduced catalytically with hydrogen.



③ Reduction of alkynes. Catalytic hydrogenation of alkynes, gives completely reduced products. Alkynes can be reduced partially to give Z-alkenes by Pd-CaCO₃ (Lindlar's catalyst) catalyst which has been deactivated by the addition of Pb-acetate. The lead treatment poisons the Pd catalyst rendering it less active and the reaction more selective.



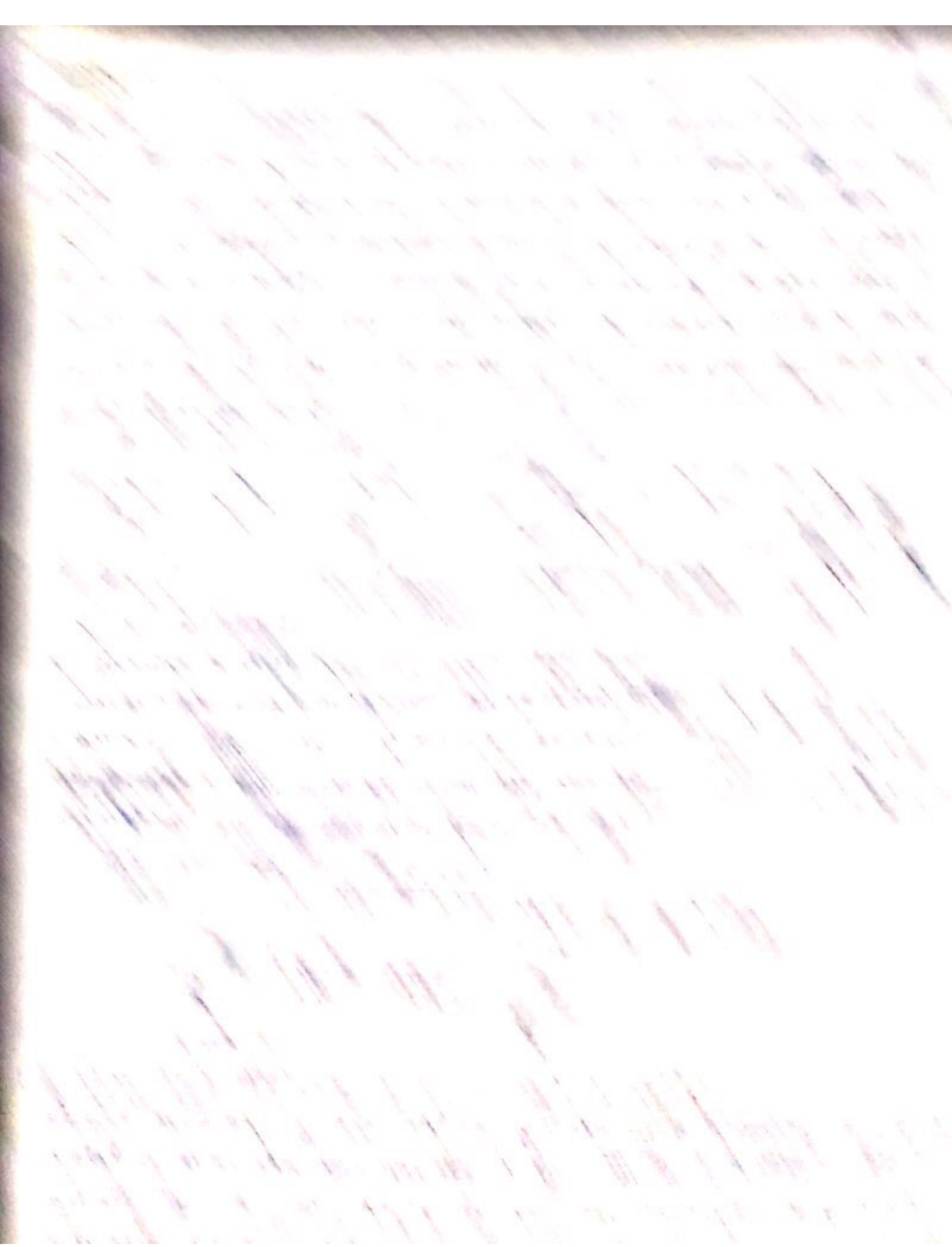
~~④ Reduction of Aromatic Compounds~~

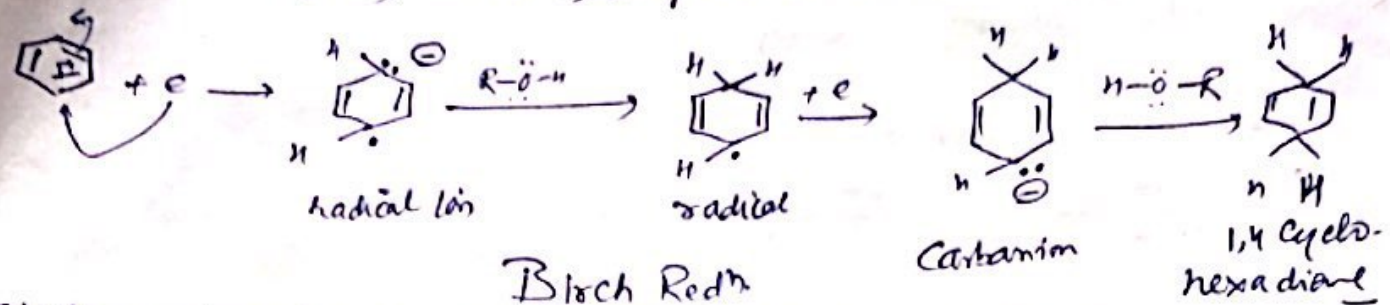
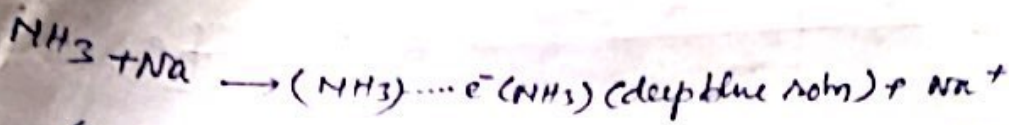
④ Homogeneous Catalytic Hydrogenation

Heterogeneous catalytic hydrogenation suffers from several disadvantages -

- ① Lack of selectivity when more than one unsaturated centre is present
- ② Double bond mig. occurs
- ③ Some groups suffer an easy hydrogenolysis
- ④ Difficulty in predicting stereochemical effect

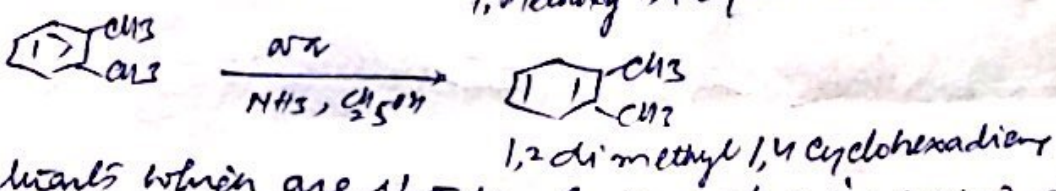
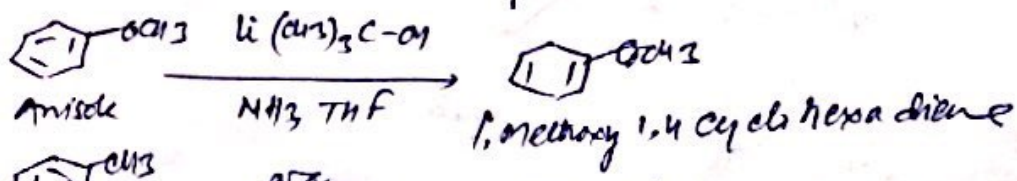
These difficulties have overcome by homogeneous catalytic hydrogenation in which metal is replaced by soluble complex of Rhodium or Ruthenium. Several soluble catalysts have been employed but most effective are those derived from Ru or Rh.





Birch Redn

Electron releasing groups retard electron transfer, electron releasing groups facilitate redn. Alkyl and alkoxy ~~retards~~ aromatic, phenols and benzoate anions are most useful substrate for Birch redn. Several functional groups eg. ketone and nitro are reduced in preference to the aromatic ring.



Substituents which are strongly electron releasing (OCH₃) deactivate the aromatic ring toward Birch redn. Li is used along with THF and a weaker proton source (t-butyl alco.)

Benzene on redn with PtO₂ and H₂/Acetic acid gives cyclohexane

