* Clemmensen Reduction of Carbonyl Group :-

The reduction is carried out by heating carbonyl compound with zinc amalgam in hydrochloric acid. Amalgamation of Zn is needed to raise its hydrogen over voltage to such a level where metal survives as a reducing agent in acid solution and is not consumed in the reaction with acid to form molecular hydrogen

$$RCHO \xrightarrow[HCl,\ reflux]{Zn(Hg)} RCH_3$$

$$R-\overset{O}{\overset{\|}{C}}-R \xrightarrow[HCl,\ reflux]{Zn(Hg)} RCH_2R$$

$$CH_3-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow[HCl,\ reflux]{Zn(Hg)} RCH_3CH_2CH_3$$

* Wolf - Kishner Reduction :-

Semicarbazones of carbonyl compounds on heating with NaOEt or other strong bases in a sealed tube are converted to $-CH_2-$ group at 200°C. The reduction is known as Wolf - Kishner reduction

$$\begin{matrix} R \\ R \end{matrix}\!\!>\!C=O + NH_2CONHNH_2 \longrightarrow \begin{matrix} R \\ R \end{matrix}\!\!>\!C=NCONHNH_2 \xrightarrow[200^\circ C]{NaOEt,\ heat} \begin{matrix} R \\ R \end{matrix}\!\!>\!CH_2 + NH_3 + N_2 + CO_2$$

Wolf-Kishner reduction is modified by heating hydrazone of carbonyl compound with sodium hydroxide in a high boiling solvent like ethylene glycol at 180°C-200°C

$$R-CHO \xrightarrow{NH_2NH_2} RCH=NNH_2 \xrightarrow[\text{glycol}]{NaOH} R-CH_3 + N_2$$

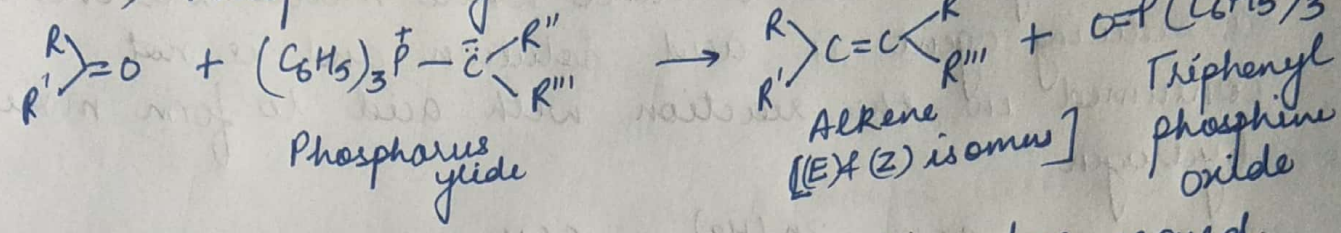
180-200°C

$$CH_3COCH_3 \xrightarrow[\text{Ethylene glycol}]{NH_2NH_2 + NaOH} CH_3CH_2CH_3$$

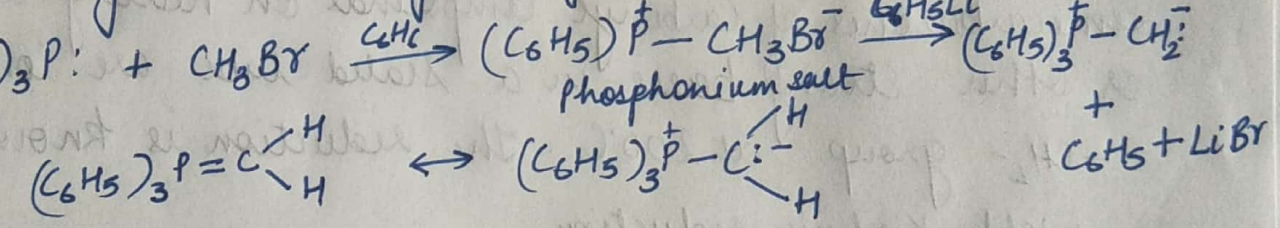
180 - 200°C

Wittig Reaction :-

Aldehyde and Ketones react with phosphorus ylides to yield alkenes and triphenylphosphine oxide. (A ylide is a neutral molecule having a negative Carbon adjacent to positive hetro atom.) Phosphorus ylides are also called phosphoranes:

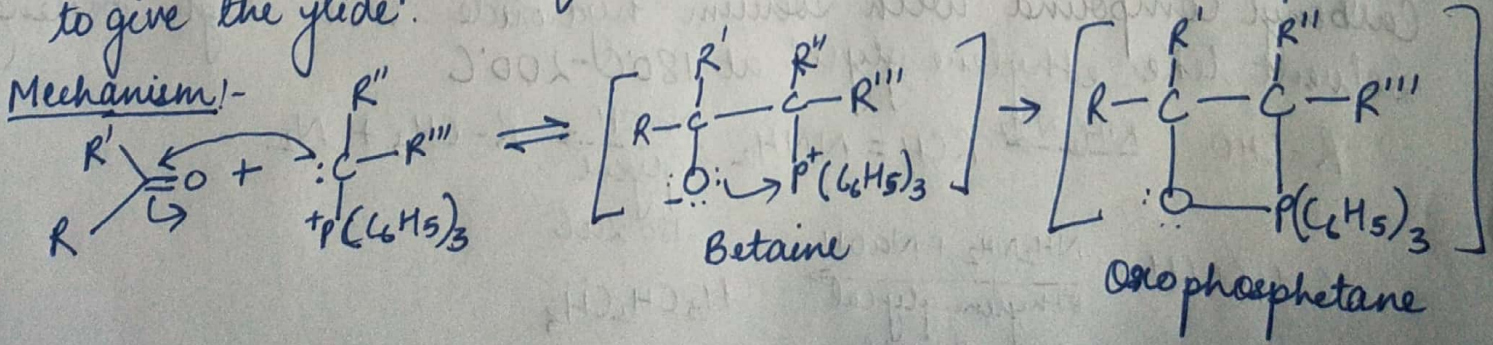


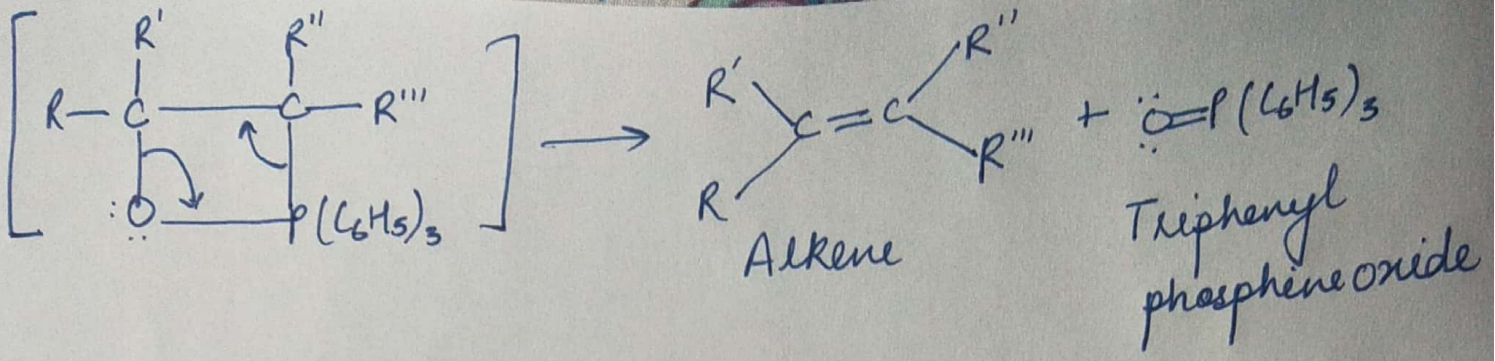
This reaction, known as the wittig reaction, has proved to be a valuable method for synthesizing alkenes. Wittig reaction offers a great advantage over most other alkene synthesis in that no ambiguity exist as to the location of the double bond in the product. (This is in Contrast to E_1 & E_2 eliminations which may produce multiple products.) Phosphorus ylide are easily prepared from triphenylphosphine and primary or secondary alkyl halides.



The first step is a nucleophilic substitution reaction. Triphenyl phosphine is an excellent nucleophile and a weak base. It readily react with alkyl halide by S_N2 mechanism to displace a halide ion from alkyl halide to give an alkyltriphenylphosphonium salt and then a strong base is added which removes a proton from Carbon that is attached to phosphorus to give the ylide.

Mechanism:-





In this mechanism ylide acting as a carbocation, attacks the carbonyl carbon of the aldehyde or ketone to form an unstable intermediate with separated charges called a betaine. In the next step, the betaine is envisioned as becoming an unstable four membered cyclic system called oxophosphetane which then spontaneously loses triphenylphosphine oxide to become an alkene