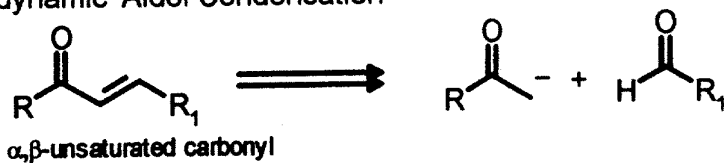
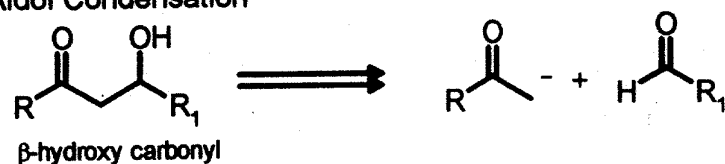


59-331/333 Product elements as Keys for Retrosynthetic Analysis

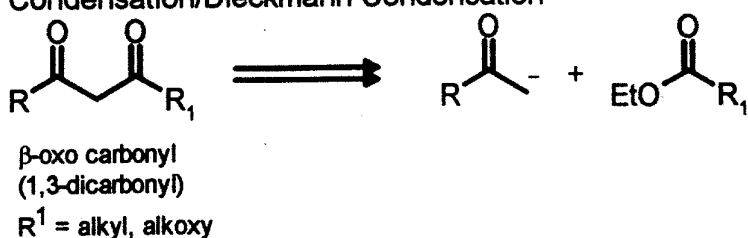
1. 'Thermodynamic' Aldol Condensation



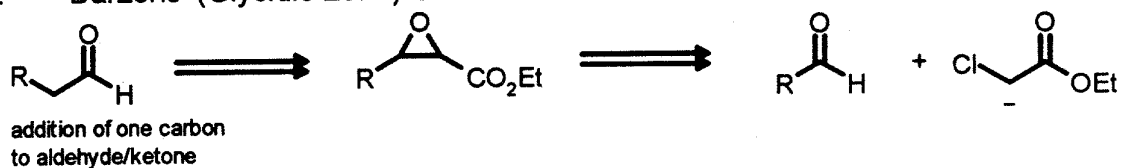
2. Kinetic Aldol Condensation



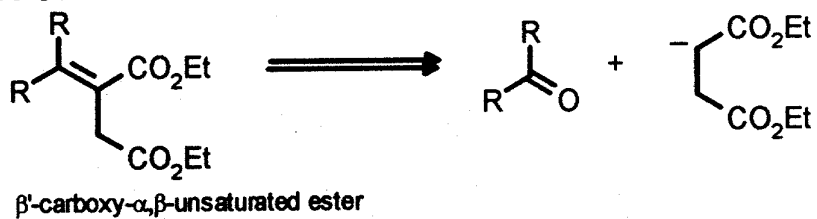
3. Claisen Condensation/Dieckmann Condensation



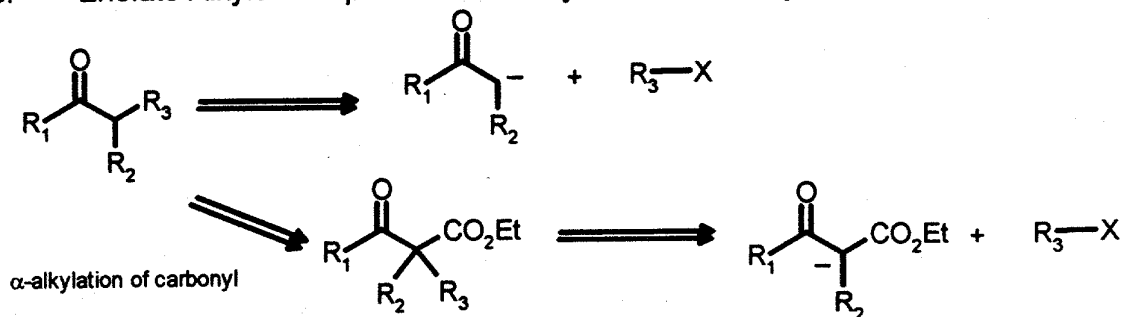
4. Darzens' (Glycidic Ester) Condensation



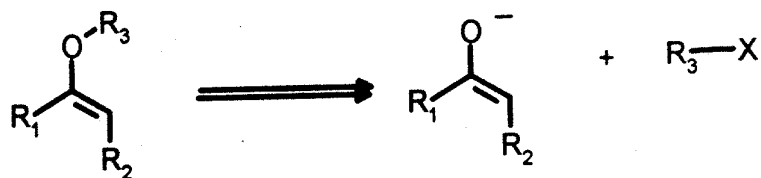
5. Stobbe Condensation



6. Enolate Alkylation / β -Keto Ester Alkylation/Decarboxylation

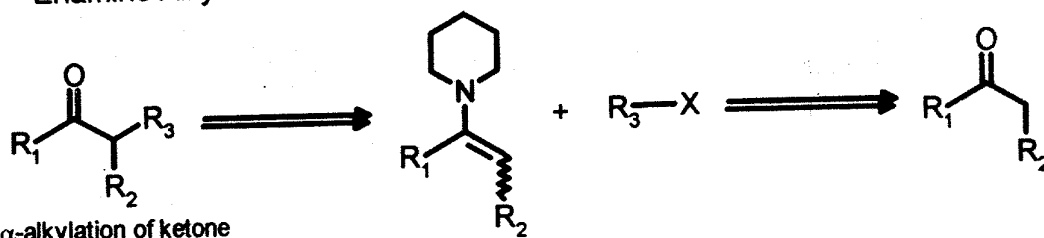


7. Enolate O-Alkylation/Acylation/Silylation



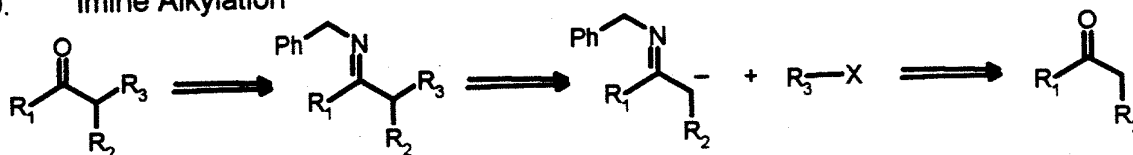
enol ether/ester/silane

8. Enamine Alkylation



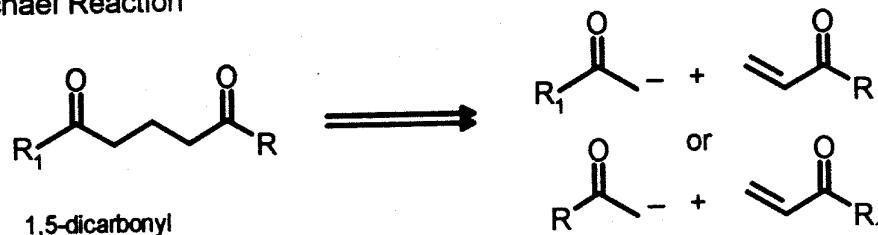
α -alkylation of ketone

9. Imine Alkylation



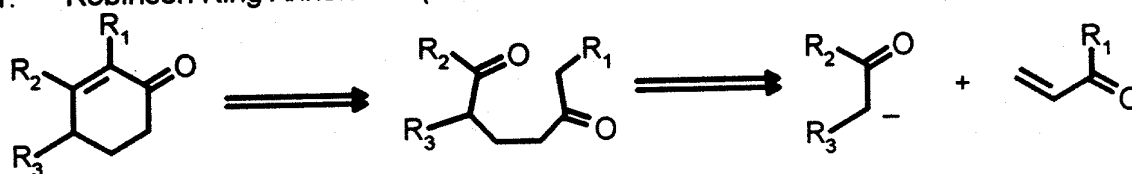
α -alkylation of carbonyl

10. Michael Reaction



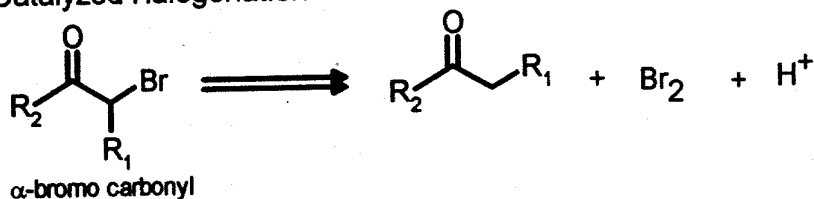
1,5-dicarbonyl

11. Robinson Ring Annelation (and its variants)



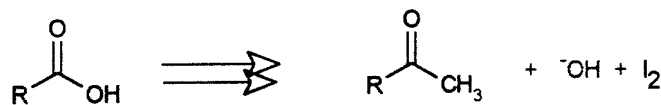
fusion of cyclohexenone ring

12. Acid Catalyzed Halogenation



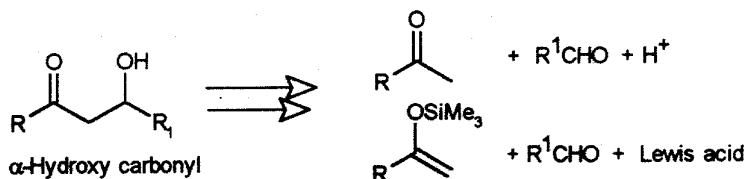
α -bromo carbonyl

13. Iodoform Reaction



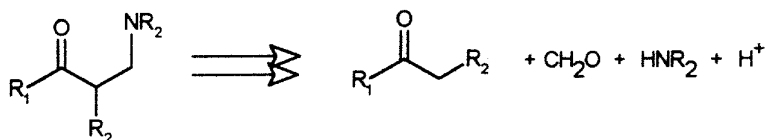
Carboxylic acid

14. Acid Catalyzed Aldol



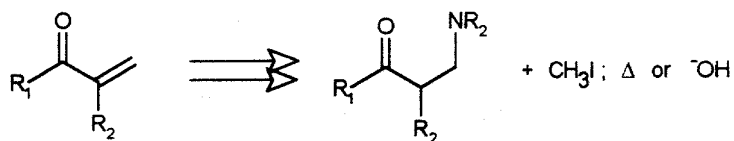
α -Hydroxy carbonyl

15. Mannich Reaction



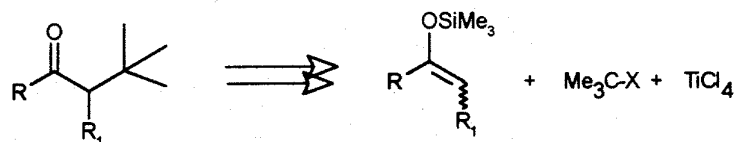
β -Amino alcohol

16. Elimination of Mannich Base



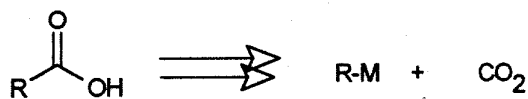
α,β -Unsaturated Carbonyl

17. Tertiary Alkylation of Silyl Enol Ethers



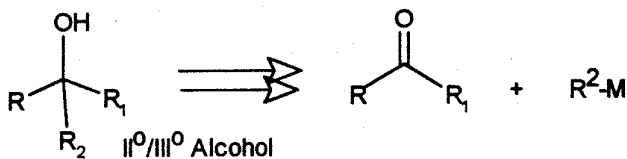
Tertiary alkylation

18. Addition of CO₂ to Organometallic



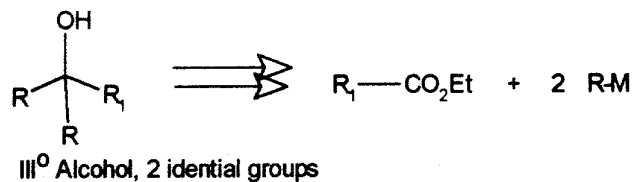
Carboxylic acid

19. Addition of Aldehyde/Ketone to Organometallic

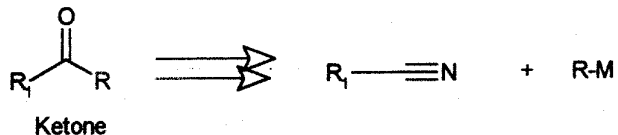


II⁰/III⁰ Alcohol

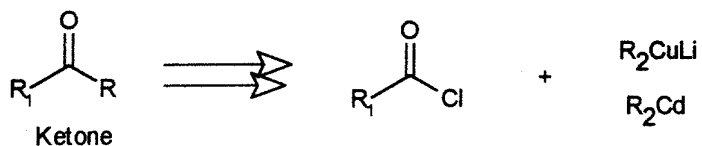
20. Bis-addition of Ester to Organometallic



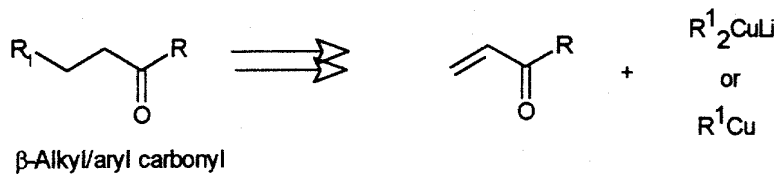
21. Addition of Nitrile to Organometallic



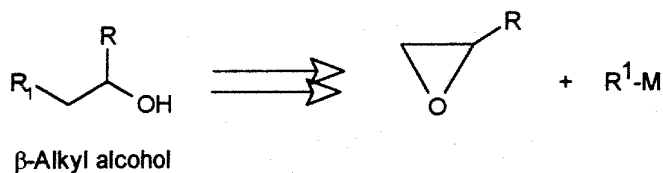
22. Addition of Acid Chloride to Cuprate/Dialkylcadmium



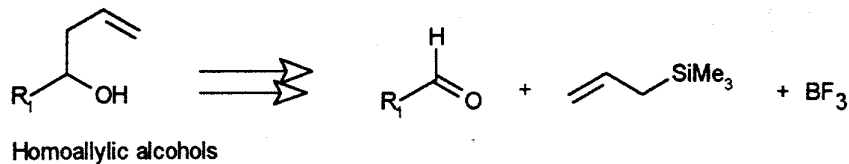
23. 1,4-(Conjugate) Addition of Cuprates/Alkylcoppers



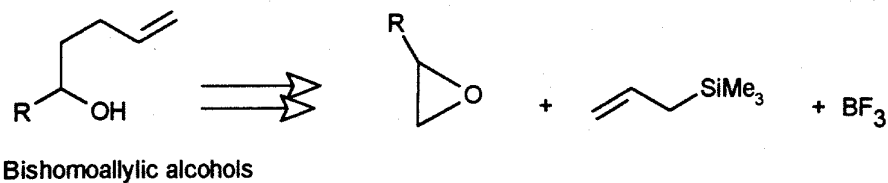
24. Addition of Epoxide to Organoemtallic



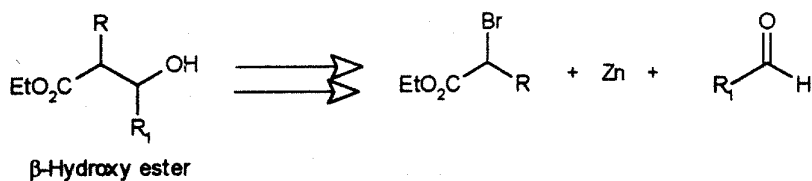
25. Allylsilane Addition to Carbonyls



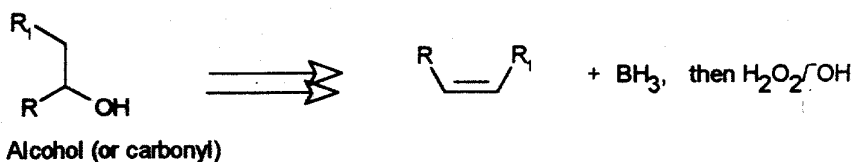
26. Allylsilane Addition to Epoxides



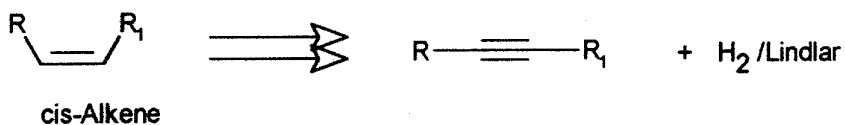
27. Reformatsky Reaction



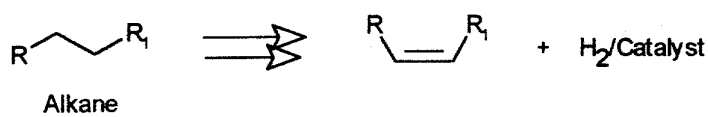
28. Hydroboration-Oxidation



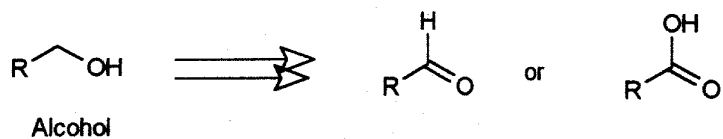
29. Hydrogenation of Alkynes



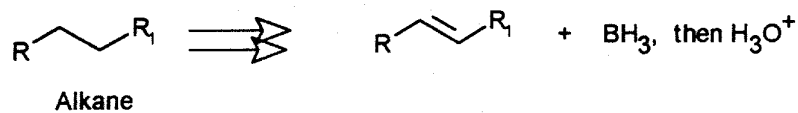
30. Hydrogenation of Alkenes



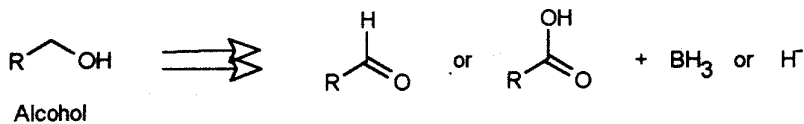
31. Hydrogenation of Carbonyls



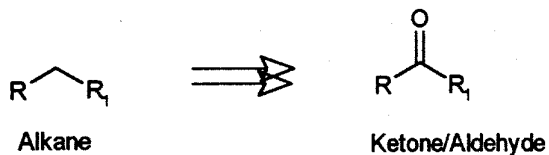
32. Hydroboration-Protonation of Alkenes



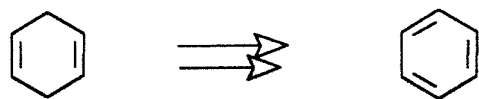
33. Hydroboration/Hydride Attack on Carbonyls



34. Clemmensen/Wolff-Kischner/Dithioacetal reduction

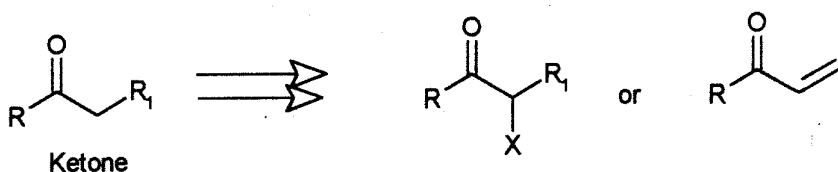


35. Birch Reduction



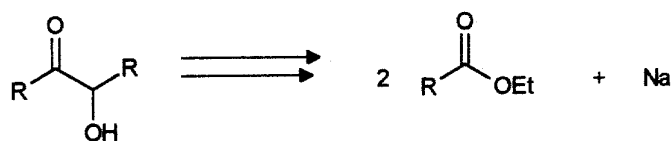
Dihydrobenzene

36. Metal Acid reduction



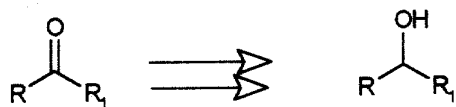
Ketone

37. Acyloin Condensation



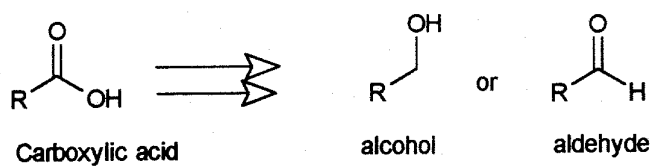
α -Hydroxy ketone

38. Oxidation of Alcohols to Aldehydes/Ketones



Ketone/Aldehyde

39. Oxidation of Alcohols/Aldehydes to Acids

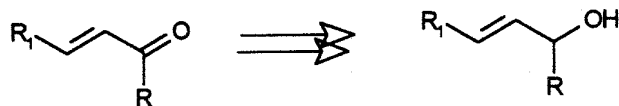


Carboxylic acid

alcohol

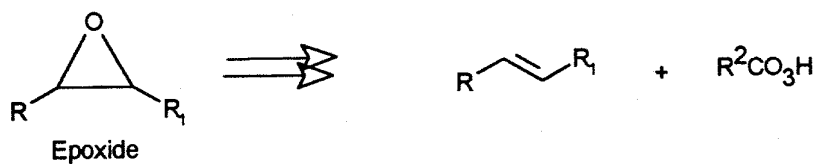
aldehyde

40. MnO_2 Oxidation



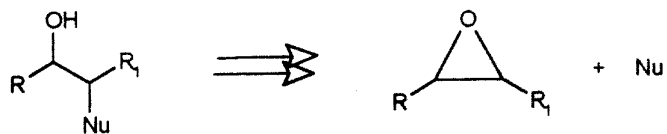
α,β -Unsaturated Ketone/Aldehyde

41. Peracid Oxidation of Alkenes



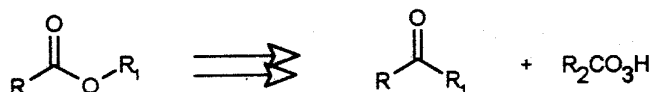
Epoxide

42. Nucleophilic Epoxide Opening (see #24)



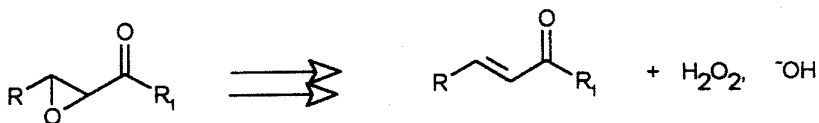
β -"Nu"-Alcohol

43. Baeyer-Villiger Oxidation



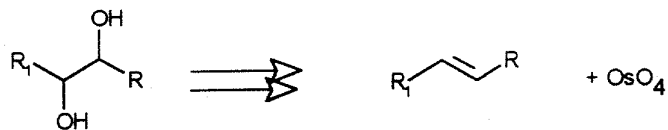
Ester/Lactone

44. Epoxidation of Unsaturated Ketones



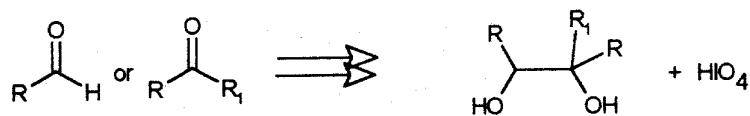
α -Epoxy ketone

45. Osmylation of Alkenes



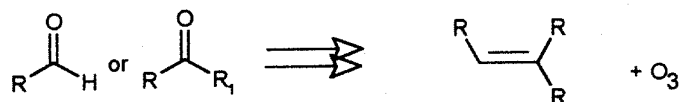
1,2-(Vicinal) Diol

46. Periodic Acid Oxidation of Diols



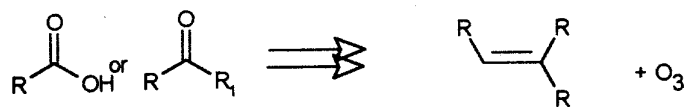
Aldehyde or Ketone
(2 molecules)

47. Ozonolysis (Reductive Workup)



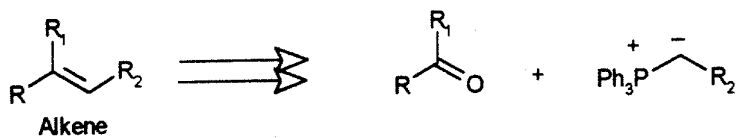
Aldehyde or Ketone
(2 molecules)

48. Ozonolysis (Oxidative Workup)

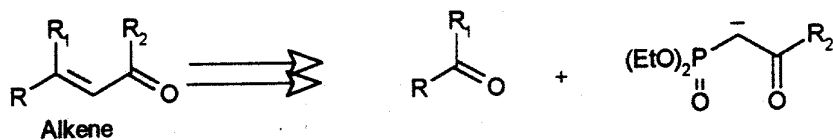


Acid or Ketone
(2 molecules)

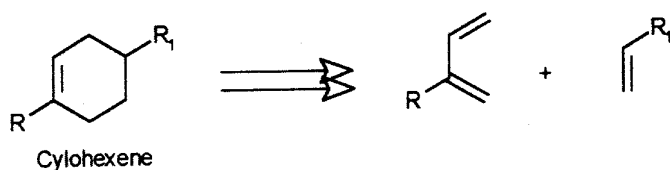
49. Wittig Reaction



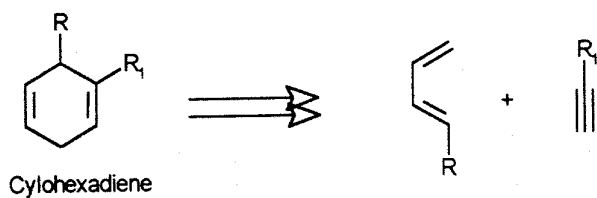
50. Wadsworth-Horner-Emmons Reaction



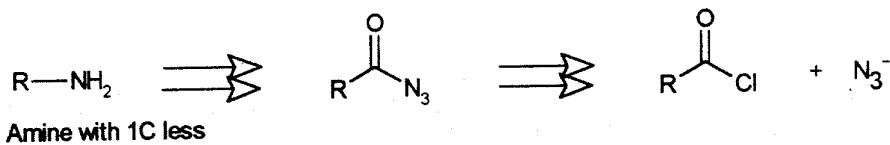
51. Diels-Alder Reaction



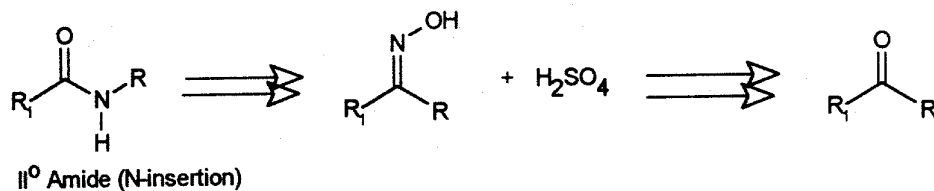
52. Diels-Alder Reaction



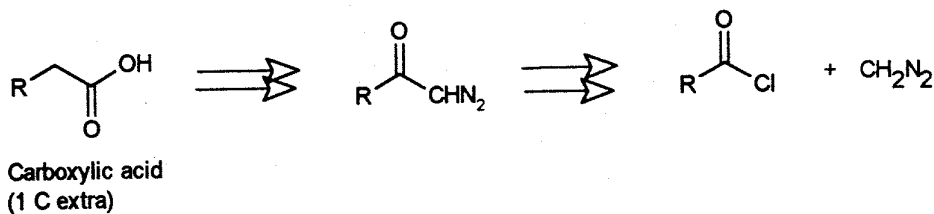
53. Curtius Rearrangement



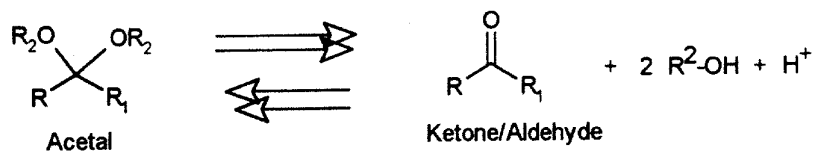
54. Beckmann Rearrangement



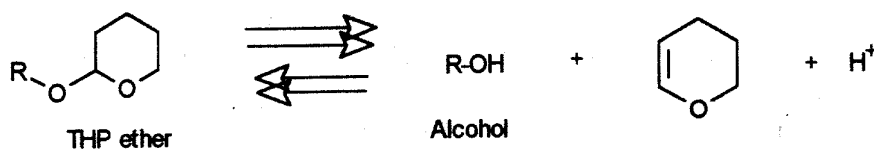
55. Arndt-Eistert



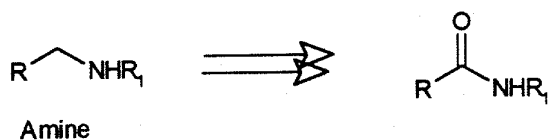
56. (De)-Protection of Ketone/Aldehyde



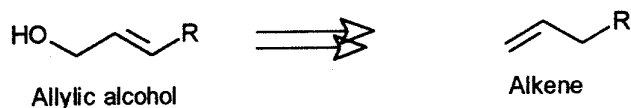
57. (De)-Protection of Alcohols



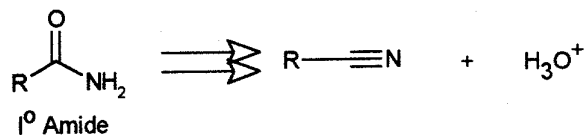
58. Reduction of Amide



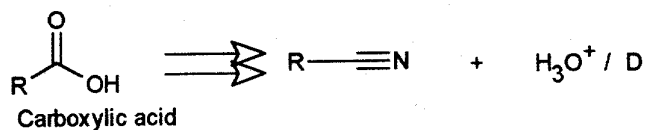
59. Selenium Dioxide Oxidation



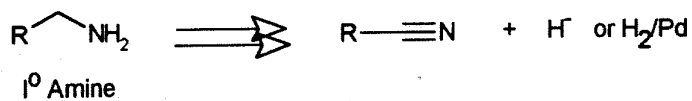
60. Nitrile Hydrolysis



61. Nitrile Hydrolysis



62. Nitrile Reduction



63. Cyanohydrins as Acyl Anion Equivalents

