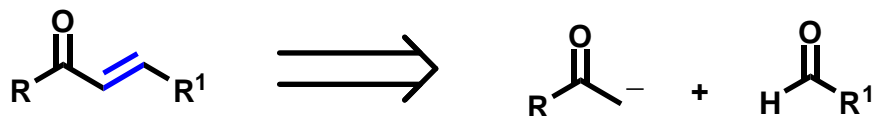


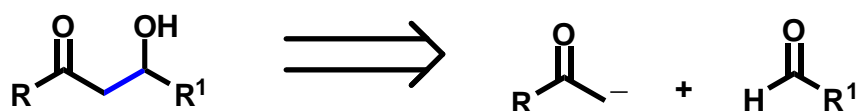
59-331/333 Product Elements as Keys for Retrosynthetic Analysis

1. Base Catalyzed ('Thermodynamic') Aldol Condensation



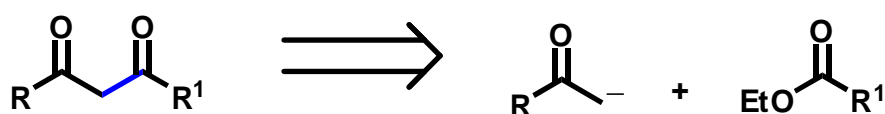
α,β -unsaturated carbonyl

2. Kinetic Aldol Condensation



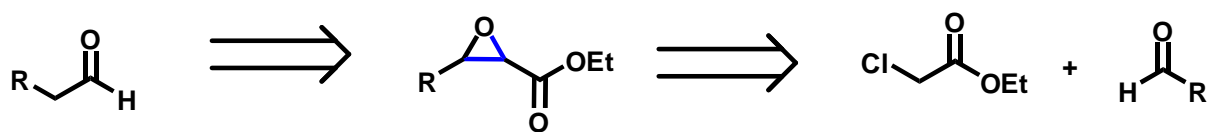
β -hydroxy carbonyl

3. Claisen Condensation/Dieckmann Condensation



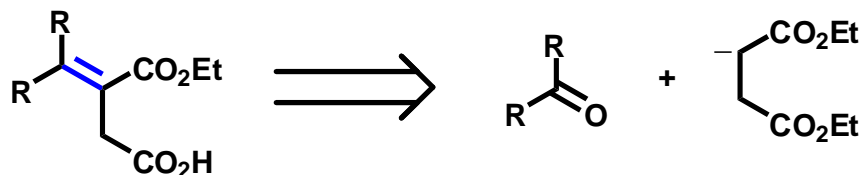
1,3-dicarbonyl
(β -oxo carbonyl)

4. Darzens' (Glycidic Ester) Condensation

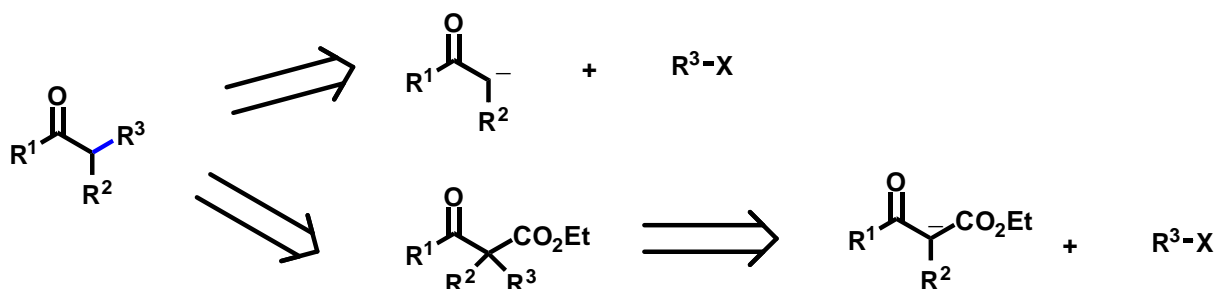


one carbon extension
of aldehyde/ketone

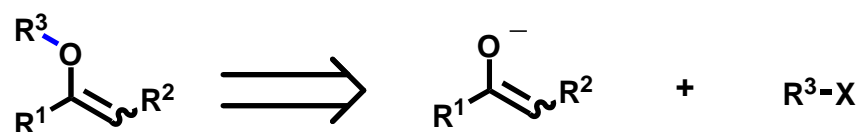
5. Stobbe Condensation – *not taught 2012*



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

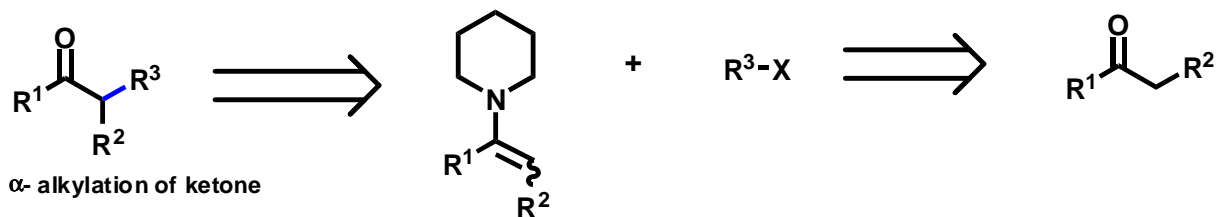


7. Enolate O-Alkylation/Acylation/Silylation

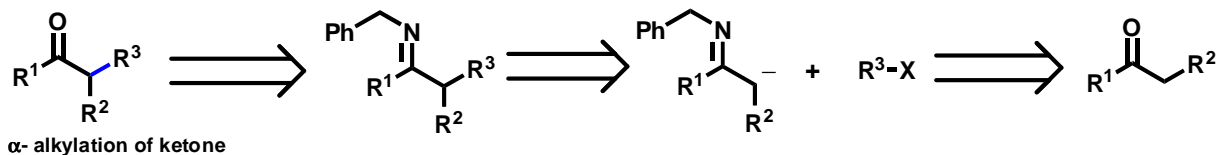


enol ether/ester/silane

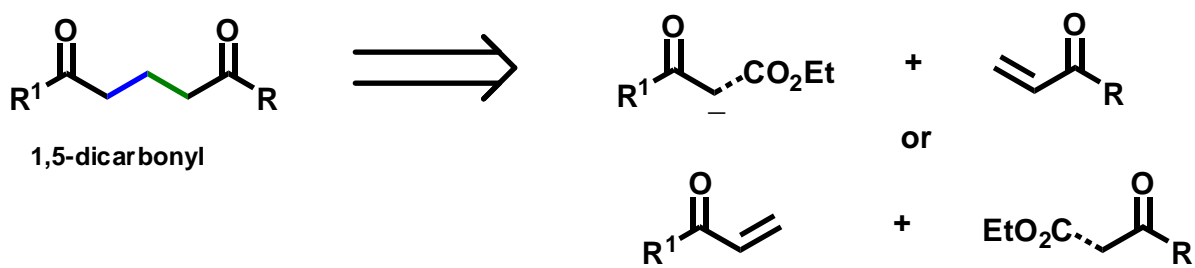
8. Enamine Alkylation



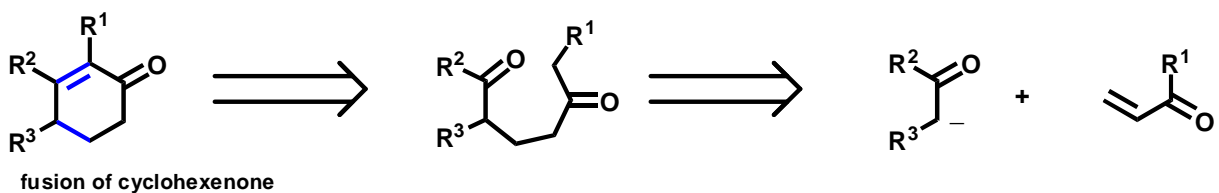
9. Imine Alkylation



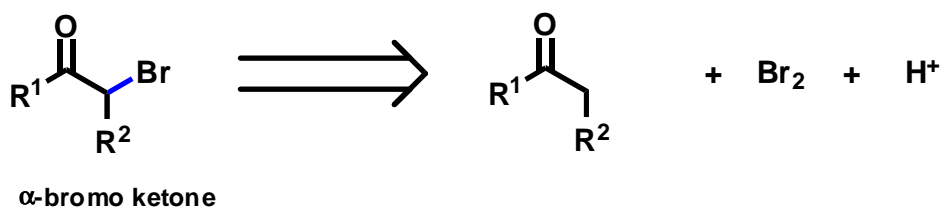
10. Michael Reaction



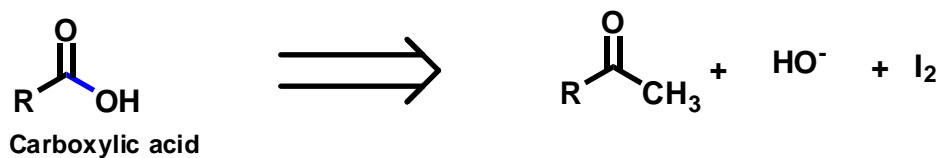
11. Robinson Ring Annulation (and its variants)



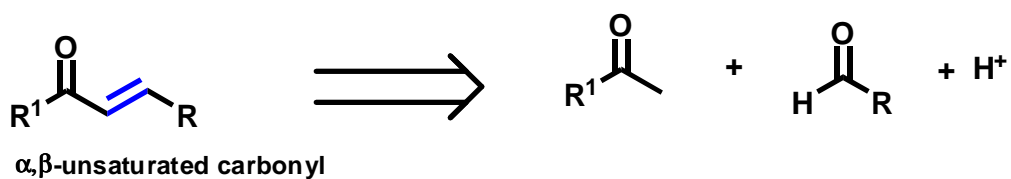
12. Acid Catalyzed Halogenation



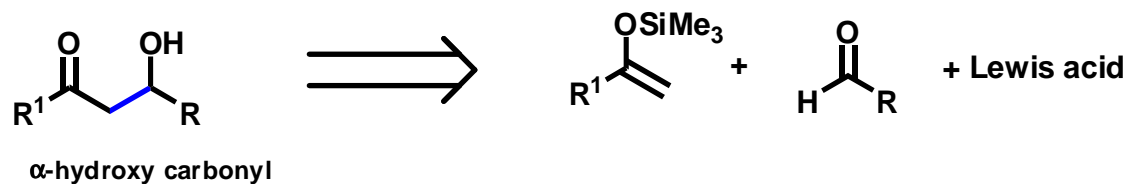
13. Iodoform Reaction



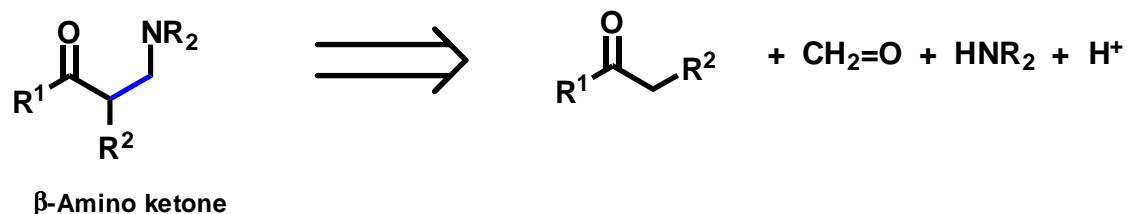
14. Acid Catalyzed Aldol



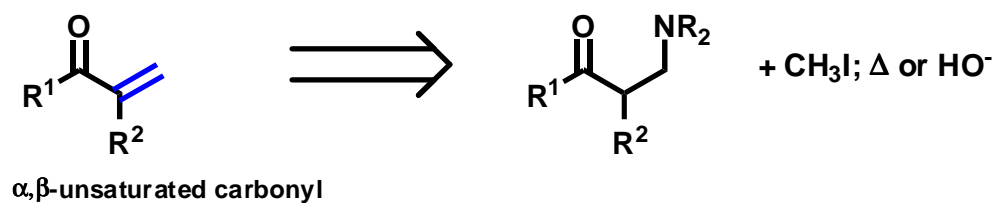
15. Lewis Acid Mediated Aldol



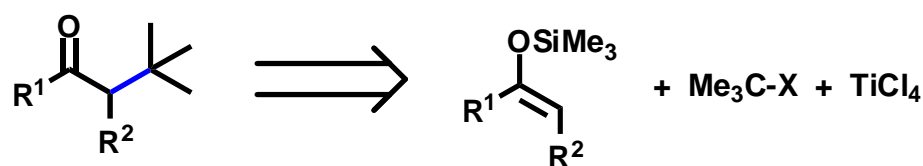
16. Mannich Reaction



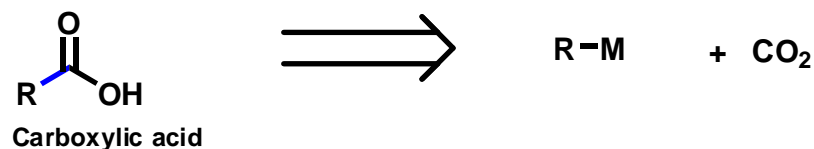
17. Elimination of Mannich Base



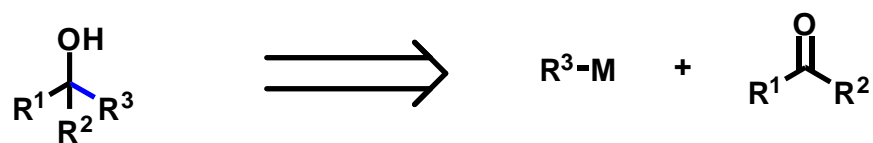
18. Tertiary Alkylation of Silyl Enol Ethers – *not taught 2012*



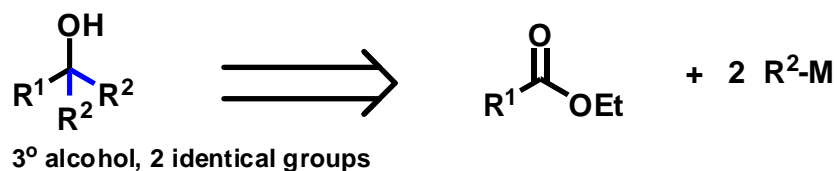
19. Addition of Organometallics to CO_2



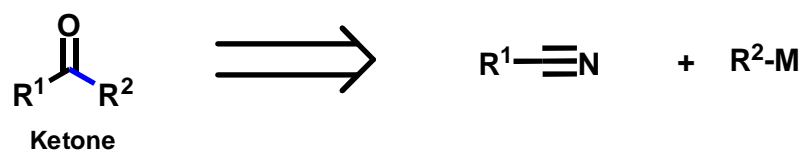
20. Addition of Organometallics to Aldehyde/Ketone



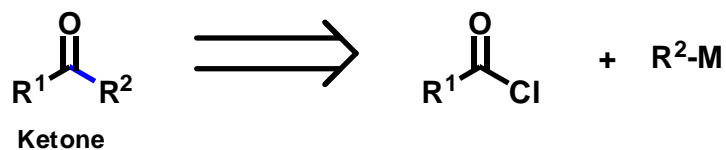
21. Di-addition of Organometallics to Esters



22. Addition of Organometallics to Nitriles



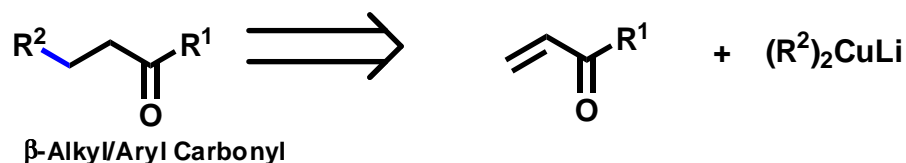
23. Addition of Cuprates to Acid Chlorides



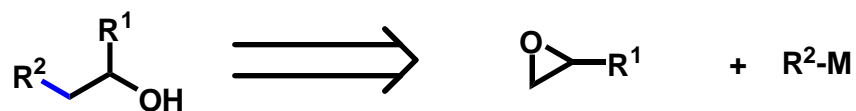
24. Addition of Organometallics to Weinreb Amides



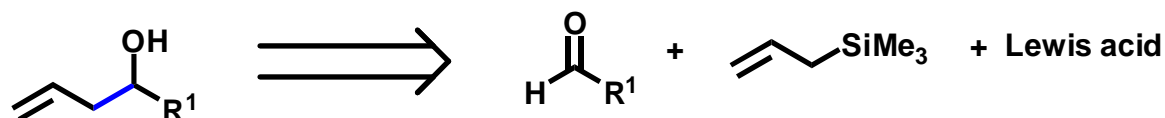
25. 1,4-(Conjugate) Addition of Cuprates



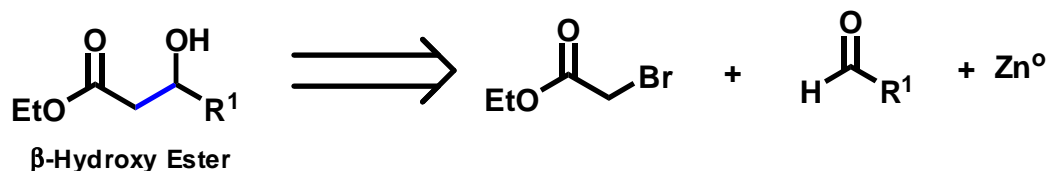
26. Addition of Organometallics to Epoxides



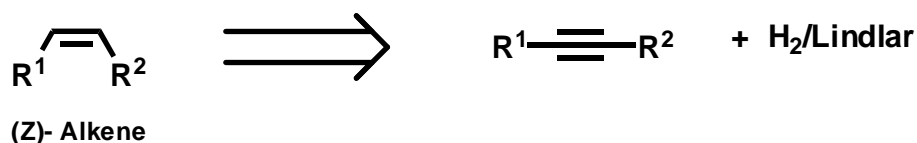
27. Addition of Allylsilanes to Aldehydes/Ketones – *not taught in 2012*



28. Reformatsky Reaction – *not taught in 2012*



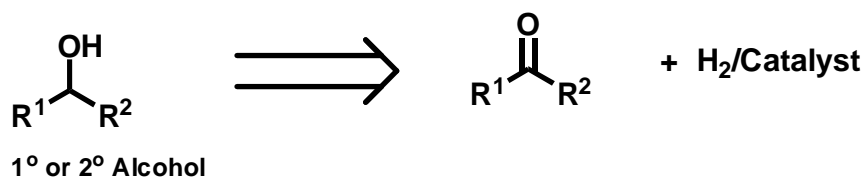
29. Hydrogenation of Alkynes



30. Hydrogenation of Alkenes



31. Hydrogenation of Ketones/Aldehydes



32. Hydroboration-Oxidation of Alkenes



Alcohol (anti-Markovnikov)

33. Hydroboration-Protonation



Alkane

34. Hydroboration of Aldehydes/Ketones



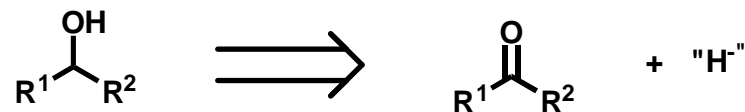
1° or 2° Alcohol

35. Hydroboration of Carboxylic Acids



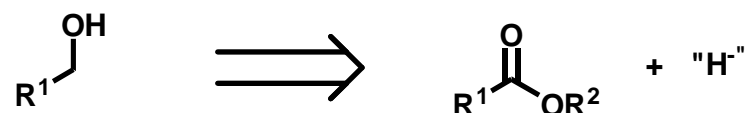
1° Alcohol

36. Hydride Attack on Aldehydes/Ketones



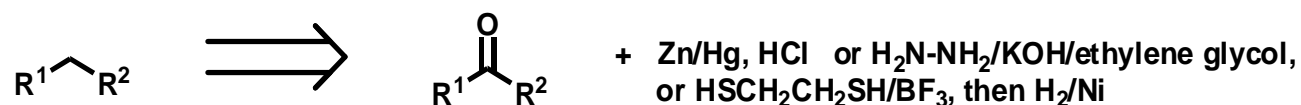
1°/2° Alcohol

37. Hydride Attack on Esters/Acids



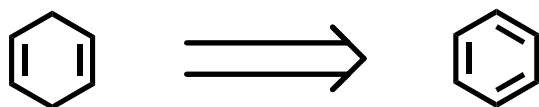
1° Alcohol

38. Clemmensen/Wolff-Kischner/Dithioacetal Reduction



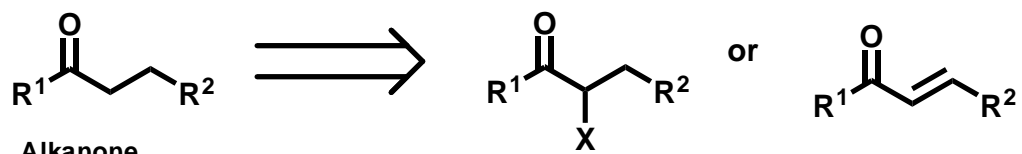
Alkane

39. Birch Reduction



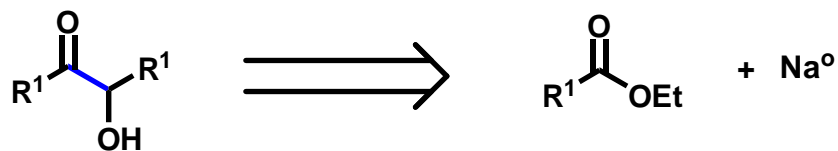
1,4-cyclohexadiene

40. Metal-Acid reduction



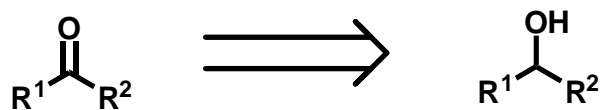
Alkanone

41. Acyloin Condensation



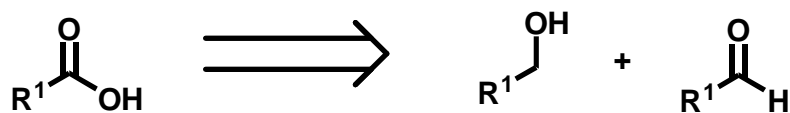
α -Hydroxy ketone

42. Oxidation of Alcohols to Aldehydes/Ketones



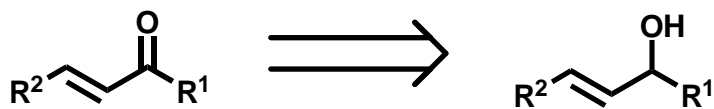
Ketone/Aldehyde

43. Oxidation of 1° Alcohols/Aldehydes to Acids



Acid

44. MnO₂ Oxidation



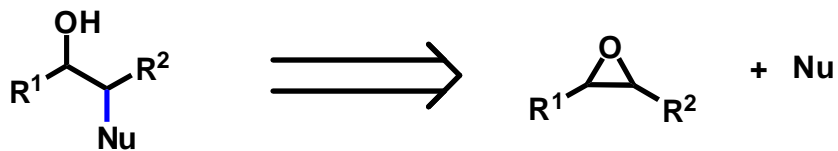
α,β -Unsaturated Aldehyde/Ketone

45. Peracids Oxidation of Alkenes



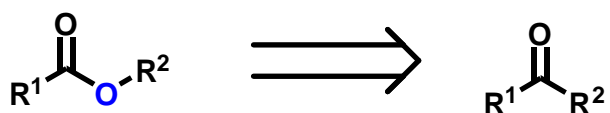
Epoxide

46. Nucleophilic Ring Opening of Epoxides (see #26)



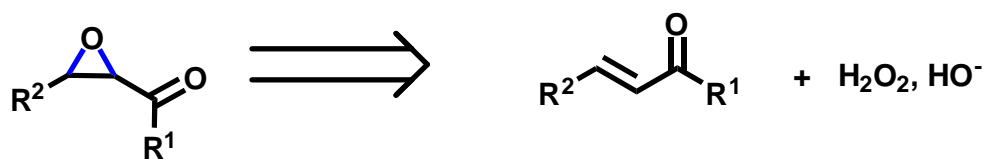
β -"Nu" Alcohol

47. Baeyer-Villiger Oxidation



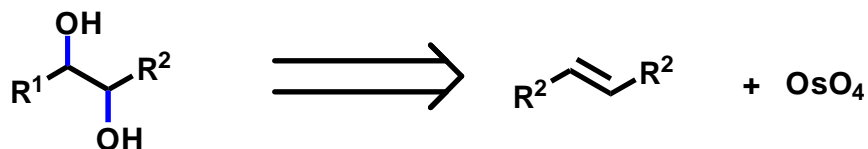
Ester/Lactone

48. Epoxidation of Unsaturated Ketones



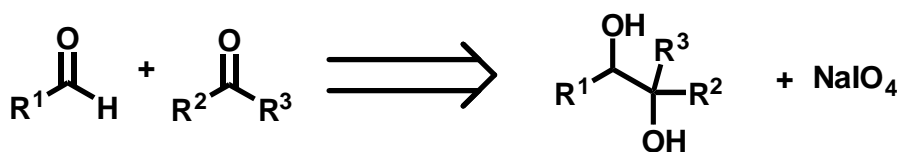
Epoxy Ketone

49. Osmylation of Alkenes

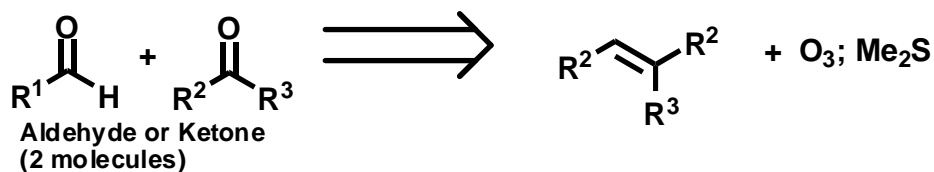


1,2-Diol

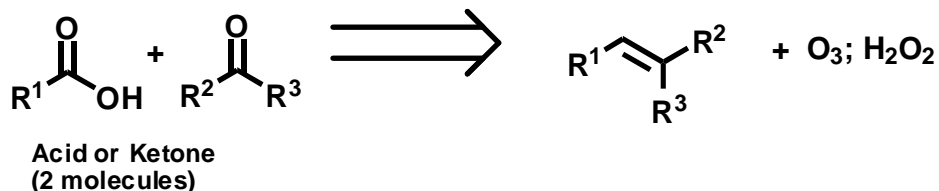
50. Periodate Oxidation of Vicinal Diols



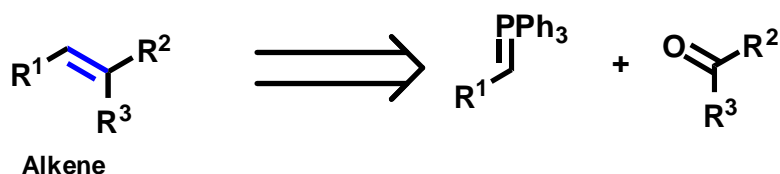
51. Ozonolysis (Reductive Workup)



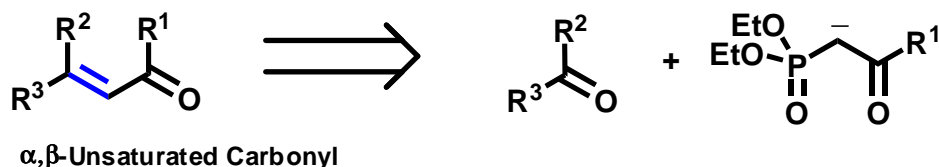
52. Ozonolysis (Oxidative Workup)



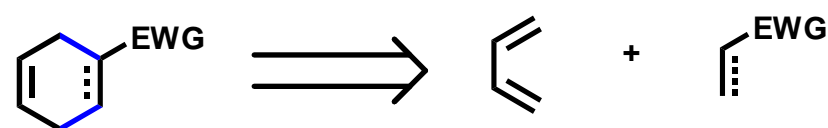
53. Wittig Reaction



54. Horner-Wadsworth-Emmons Reaction

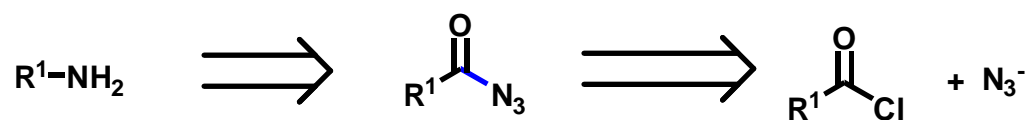


55. Diels-Alder Reaction



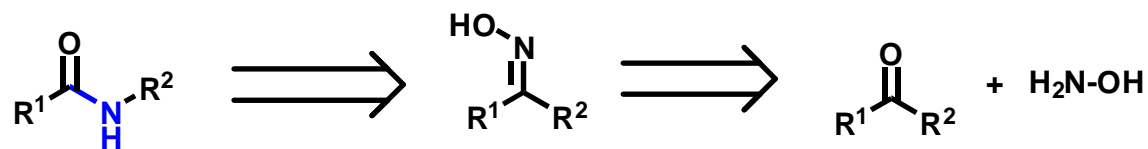
Cyclohexene/Cyclohexadiene

56. Curtius Rearrangement



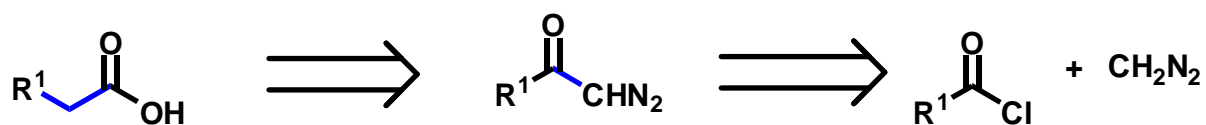
Amine with 1C less

57. Beckmann Rearrangement



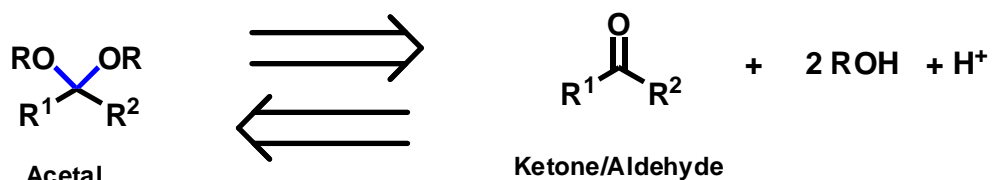
Amide/Lactam

58. Arndt Eistert Synthesis



Acid with 1C more

59. Protection/Deprotection of Ketone/Aldehyde



60. Protection/Deprotection of Alcohols

