Organic Reaction Table V-3 (May ’19)

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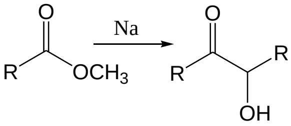
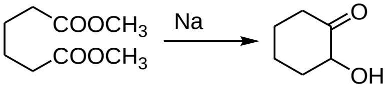
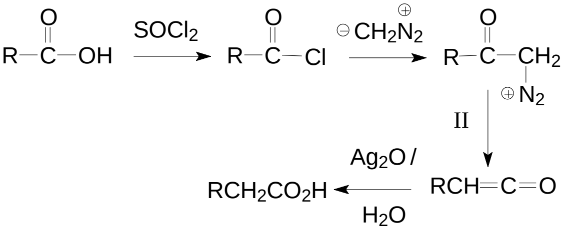
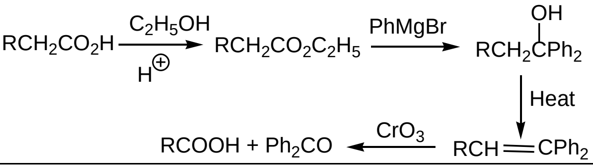
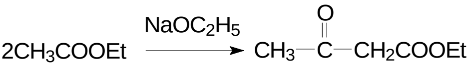
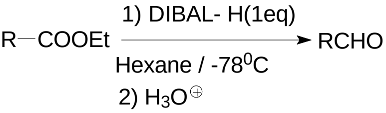
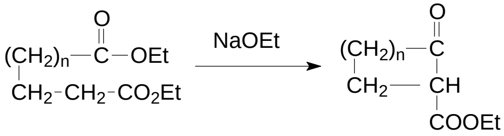
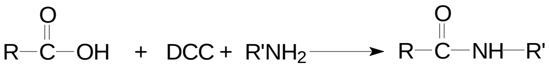
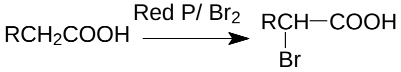
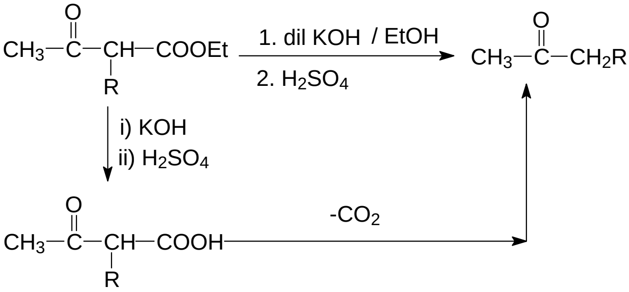
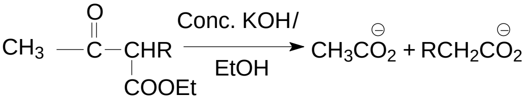
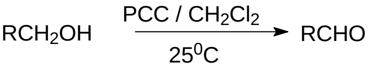
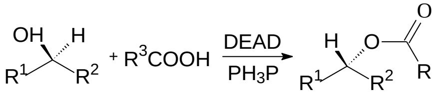
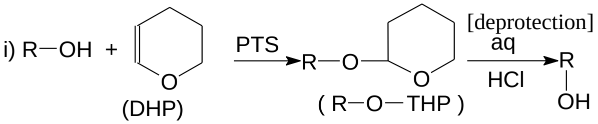
(NOTE: References are provided as a separate part after page 32)

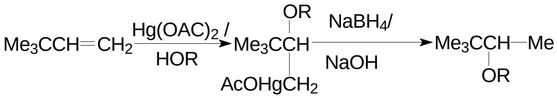
	ACIDS AND ESTERS
S.N.	**REACTION**
1.	**Acyloin Condensation** **Acyclic version**  **Cyclic version** 
2.	**Arndt-Eistert Synthesis and Wolf rearrangement**  ***Note:*** *The rearrangement of Diazoketone in step II is Wolf-rearrangement*
3.	**Barbier-Wieland Degradation** 
4.	**Claisen Reaction/ Condensation** 
5.	**Ester to aldehyde conversion**  *DIBAL-H: Diisobutyl Aluminium Hydride*

6.	**Dieckmann Reaction or condensation** 
7.	**DCC coupling of acid and amine** 
8.	**Hell Volhard Zelinsky Reaction (HVZ Reaction)** 
9.	**Reaction of beta-keto ester with KOH** Formation of ketone  Formation of acid (salt)  ***Note***: *Palladium acetate/triphenylphosphine/ammonium formate can also be used for decarboxylation of beta-keto ester*

ALCOHOLS / ETHERS	
10.	**Conversion to aldehyde** 

11.	**Jones Oxidation** $R_2CHOH \xrightarrow{CrO_3 / H_2SO_4} R_2C=O$ ***Note:*** *$CrO_3.2C_5H_5N$ (Chromium trioxide-pyridine complex) can also be used*
12.	**Conversion to Iodide** $R-OH \xrightarrow[CH_2Cl_2]{I_2 / PPh_3 / imidazole /} R-I$ ***Note:*** *Very good yield for primary, secondary or tertiary alcohol*
13.	**Conversion to Chloride** $ROH \xrightarrow{PCl_5} R-Cl$ ***Note:*** *Thionyl chloride can also be used*
14.	**Mitsunobu Reaction**  ***Note:*** *The reaction proceeds with clean inversion of configuration*
15.	**Oppenauer Oxidation** $R_2CHOH \xrightarrow[2.\ dil\ H_2SO_4]{1.\ Al(\textit{tert}\text{-}BuO)_3 / Acetone} R_2C=O$ ***Note:*** *It does not affect double bond*
16.	**Protection of alcohol followed by deprotection**  DHP = Dihydropyran THP=Tetrahydropyran PTS = *p*-toluenesulfonic acid ***Note:*** *Bis(trimethylsilyl)sulfate or $ZrCl_4$ can also be used instead of PTS as catalyst* ii) $ROH + PhCH_2Cl \longrightarrow ROCH_2PH \xrightarrow{H_2 / Pd} R-OH$
17.	**Williamson Synthesis** $R-OH + Na \longrightarrow RONa$ $R-ONa + R'I \longrightarrow ROR' + NaI$ ($R'=1^0$; $R= 1^0, 2^0$, or 3^0)

18. **Oxymercuration- Demercuration to produce ether**



Note: *Almost 100% Murkownikof addition for oxymercuration reaction*

ALKANE

19. **Corey-House Synthesis**

$$RX + Li \longrightarrow RLi \xrightarrow{CuI} R_2CuLi$$

$$R'X + R_2CuLi \xrightarrow{THF/-78\ ^{o}C} R-R'$$

$(R = 1^0, 2^0 \text{ not } 3^0)$

20. **Finkelstein Reaction**

$$RCl + NaI \xrightarrow{Acetone} RI + NaCl\downarrow$$

21. **Phase Transfer Catalyst (PTC)**

$$\underset{\text{(In ether)}}{Me(CH_2)_7Br} \xrightarrow[\text{aqueous NaCN / } 105^0C]{\overset{\oplus\ominus}{(Bu)_4NBr}\text{ (PTC)}} Me(CH_2)_7CN$$

Note: *Very easy and quick transformation*

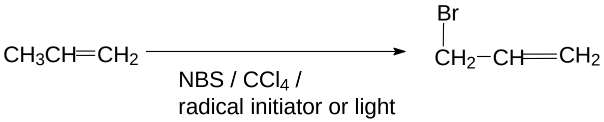
22. **Wurtz Reaction**

$$R-X + RX \xrightarrow{Na / ether} R-R + Alkene$$

Note: Reaction occurs via SN^2 or E^2 reaction sometimes, via free readical pathway

ALKENE

23. **Bromination at allylic position (Wohl-Ziegler reaction)**

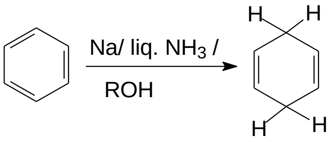


NBS = N-Bromosuccinimide

Note: *Addition of Br_2 to double bond is inhibited by low concentration*

24.

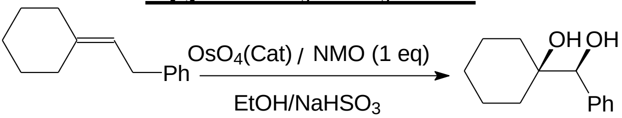
Birch reduction



Note: *Trans product is formed*

25.

Upjohn dihydroxylation

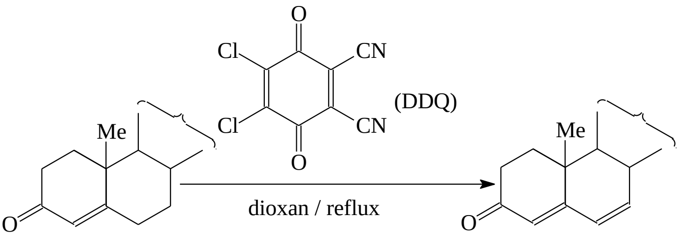


NMO = N-Methyl mprpholine-N-oxide

Note: *Can also be done by cold dil. Alkaline $KMnO_4$*

26.

D D Q (use)



DDQ : 2, 3- Dicholro -5 , 6 - dicyanobenzoquinone

(DDQ: Used for dehydrogenation process, oxidative coupling, cyclization etc)

27.

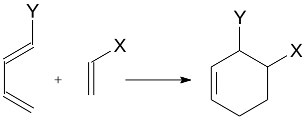
Dehalogenation reaction of vicinal dihalide

$$CH_3CH(Br)-CH_2(Br) \xrightarrow{Zn\ /\ EtOH} CH_3CH=CH_2$$

Note: *Chromous sulfate or Sexithiophene/light irradiation can also be used in place of zinc*

28.

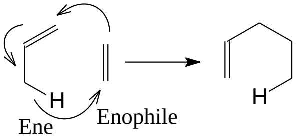
Diels-Alder reaction



Note: *Favourable when Y = electron donating group, X=electron withdrawing group*

Note: *Related reaction is hetero Diels-Alder reaction*

29. **Ene reaction Or Alder-ene reaction**

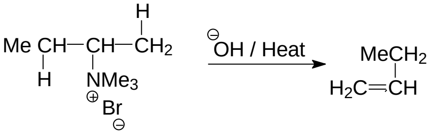


Ene: Alkene, Alkyne, Allene, Arene, Carbon-heteroatom

Enophile: C=C, C=O, C=N, C=S, O=O, N=N etc

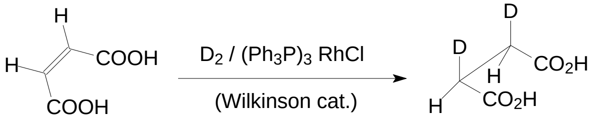
Note: *Resembles both cycloaddition and (1, 5)- sigmatropic shift*

30. **Hofmann elimination**



Note: *T. S. has carbanion like character leading to formation of terminal double bond*

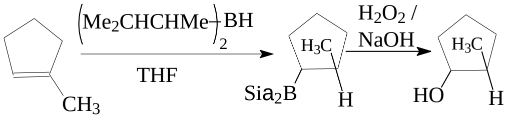
31. **Homogeneous hydrogenation of alkene**



Note: *Instead of deuterium, hydrogen can be used for hydrogenation*

Note: Hyrogenation occurs only at unhindered double bond.)

32. **Hydroboration-Oxidation**



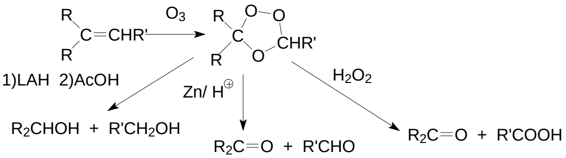
$Sia_2BH \Rightarrow (Me_2CHCHMe)_2BH$

(Disiamylborane)

(Anti-Markownikof addition)

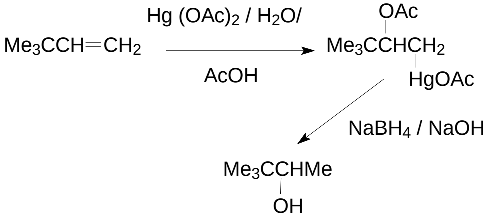
Note*: The first step can be performed by $BH_3.Et_2O$ or other boron-reagents with slightly less selectivity: originally described by Brown*

33. **Ozonolysis**



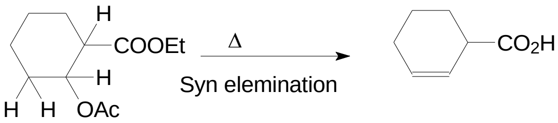
Note*: may be used to detect position and number of double bond(s))*

34. **Oxymeruration- demercuration to produce alcohol**



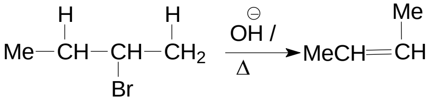
Note: *Almost 100% markownikoff addition*

35. **Pyrolysis of ester**



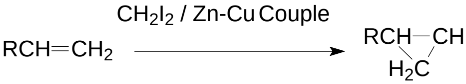
Note: *~100% syn-elimination*

36. **Saytzeff elimination**

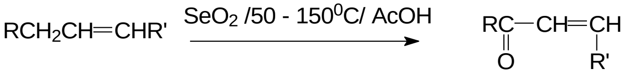


Note: *In T. S. partially double bond form to lead to non-terminal* double bond

37. **Simmons – smith reaction**

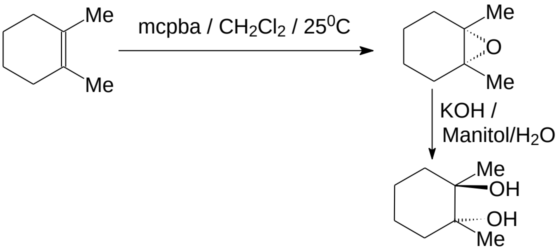


38. **SeO_2, Reaction with a double bond of RCH_2CHCHR'**



(R, R’: aryl or R: H, R’: alky)

39. **Trans-dihydroxylation (or anti-dioxylation) of alkene**

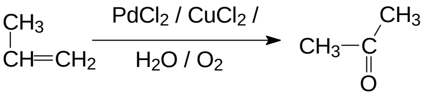


Can also be done by 1)AcOH / CH_3CO_2 Ag 2) NaOH

mcpba = meta-chloroperoxybenzoic acid

(Malonoyl peroxide can also be used instead of mcpba)

40. **Wacker Process (or Hoechst-Wacker process)**



Note: *Very efficient process and used in industry*

41. **Ziegler- Natta Catalyst**

$CH_3CH{=}CH_2 \xrightarrow{TiCL_4.\ AlEt_3}$ Polypropylene (stereoregulated)

($TiCl_4.AlEt_3$: Ziegler-Natta catalyst)

Note: *Zirconium-based metallocene complexes can also be used for stereoregulated polymerization)*

ALKYNE

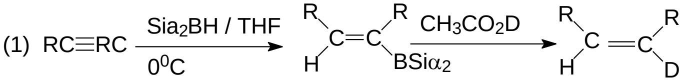
42. **Alkylation (two different processes)**

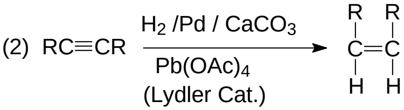
1) $HC{\equiv}CH \xrightarrow{NaNH_2\ /\ NH_3(l)} CH{\equiv}CNa \xrightarrow{MeBr} CH{\equiv}CMe$

2) $HC{\equiv}CH \xrightarrow{RMgBr} HC{\equiv}CMgBr \xrightarrow{RX} HC{\equiv}CR$

Note: *Other reagents (like n-BuLI) can also be used*

43. **Cis-hydrogenation (Two process)**





Better catalyst : 5% Pd / $BaSO_4$ / S / quinoline / MeOH/ 25 ^{0}C

Note: *See Alkene for abbreviation of boron reagent)*

Note: *BH_3.ether can also be used instead of Sia_2BH with slightly less selectivity*

44. **Conversion to alddehyde / ketone**

a) $RC\equiv CR \xrightarrow[\text{2. } H_2O_2 \text{ / NaOH}]{\text{1. } Sia_2BH \text{ / THF}} RCH_2CHO$

(AntiMarkownikoff Addiction)

b) $RC\equiv CR \xrightarrow[\text{2. } H_2O \text{ / 60 } ^0C]{\text{1. } HgSO_4 \text{ / 70\% } H_2SO_4} RCH_2CHO$

(Markownikoff Addiction)

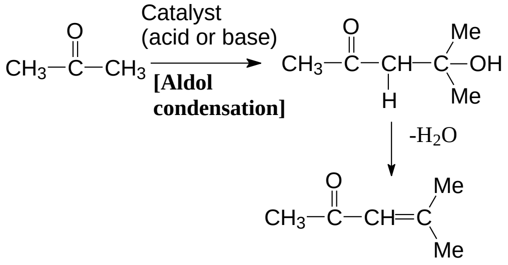
Note: *See Alkene (8) for abbreviation of boron reagent*

Note: *BH_3.ether can also be used instead of Sia_2BH with slightly less selectivity*

CARBONYL COMPOUNDS

45.

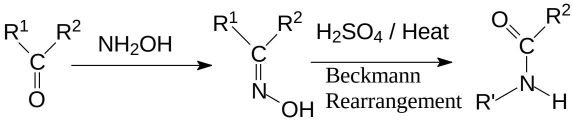
Aldol Condensation



Note: *Aldol condensation is usually followed by dehydration*

46.

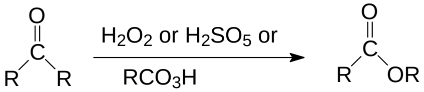
Beckmann Reaction (rearrangement)



Note: *Anti to –OH group always migrates*

47.

Baeyer villiger oxidation



Note: *Migrating aptitude is H>pH>3^0>2^0>1^0)*

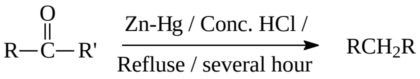
48.

Cannizzaro reaction

$PhCHO \xrightarrow[\text{NaOH}]{\text{Conc.}} PhCO_2^{\ominus} + PhCH_2OH$

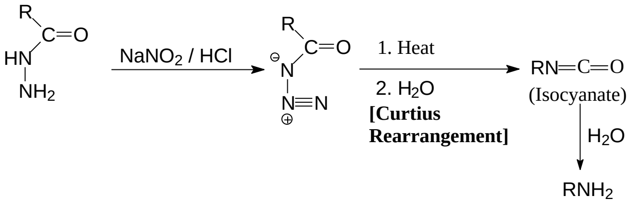
$PhCHO + HCHO \xrightarrow[\text{NaOH}]{\text{Conc.}} PhCH_2OH + HCO_2^{\ominus}$

49. Clemmensen Reduction



Note: *Unsuccessful with satirically hindered ketone*

50. Curtius rearrangement



Note: *Isocyanate can be converted to a carbamate or urethanes by reacting with an alcohol or amine respectively*

51. Conversion to R_2CH_2 in neutral condition

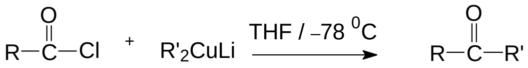
$$R_2CO \xrightarrow{R'SH \,/\, PTS \,/\, C_6H_6} R_2C(SR')_2 \xrightarrow{H_2 \,/\, Ni} R_2CH_2$$

52. Claisen-Schmidt Condensation

$$PhCHO + CH_3CHO \xrightarrow{NaOH} PhCH{=}CH{-}CHO$$

53. Corey-House Synthesis

Preparation of ketones

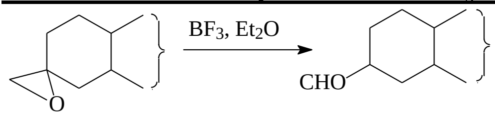


Preparation of alkanes

$$RX + R'_2CuLi \xrightarrow{THF \,/\, -78\,^{0}C} R{-}R'$$

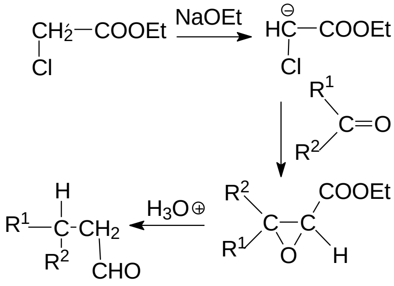
Note: *$R = 1^0, 2^0$ not 3^0 $R' = 1^0, 2^0, 3^0$*

54. Conversion of an epoxide to aldehyde



Note: *Other Lewis acids can also be used*

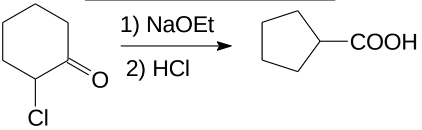
55. Darzens glycidic ester condensation and application



(Glycide Ester)

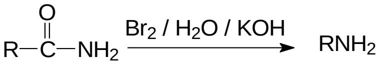
Note: *An aldehyde can be produced from a ketone using the reaction*

56. Favorskii reaction



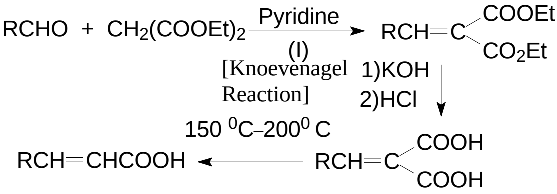
Note*: alpha-haloketone gives this type of reaction*
Note*: Related reaction: Photo-Favorskii reaction*

57. Hofmann reaction

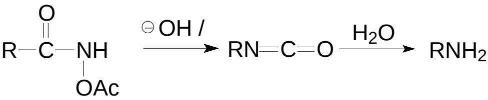


Note*: Migration with retention of configuration of R*
Note*: Pb(OAc)$_4$ can also be used*

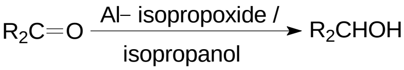
58. Knoevenagel reaction and application



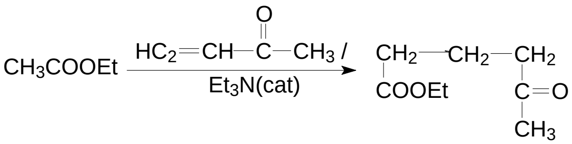
59. Lossen reaction (Rearrangement) And application



60. (MPV Reduction)



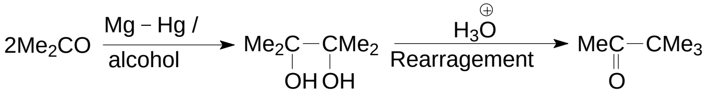
61. Michael Addition



Note: *Important for C-C bond formation*

Note: *Related reactions: Oxa-Michael, Nitro-Michael, Phospha-Michael, Aza-Micheal etc*

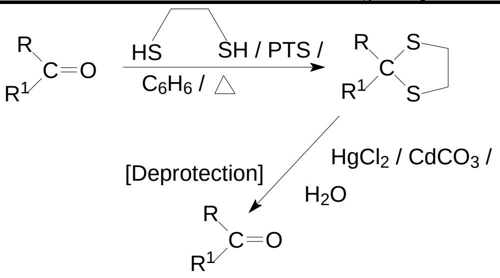
62. Pinacol formation and rearrangement



Note*: Related reaction: Aza-pinacol rearrangement*

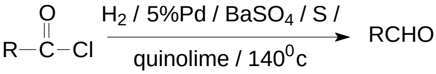
63. Perkin reaction (Condensation)

64. Protection of ketone followed by deprotection

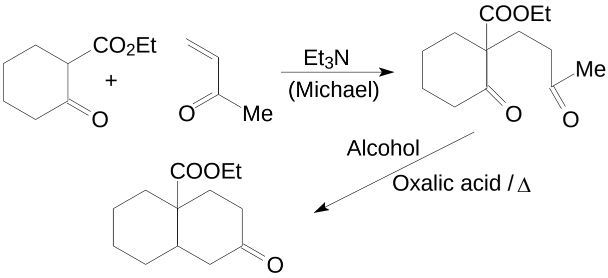


Note*: Instead of 1,2-ethanedithiol; 1,3-propanedithiol can also be used to produce 1,3-dithiane compounds*

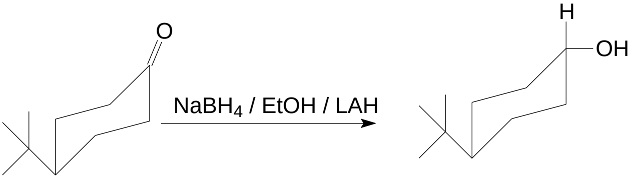
65. Rosenmund reaction



66. Robinson annulation

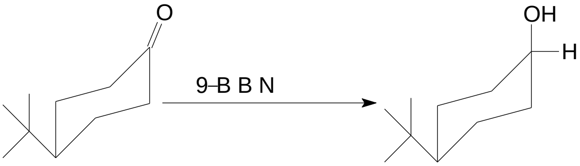


67. Reduction of cyclo hexanone to produce equatorial alcohol

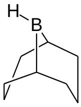


Note: *Hydride transfer agent is small so equatorial alcohol formed (Cieplak effect)*

68. Cyclohexanone reduction to produce axial Alcohol



Note*: Attacking agent is large so equitorial attack takes place*



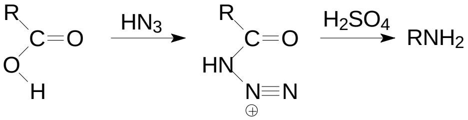
9-borabicyclo[3.3.1]nonane (9-BBN)

69. Stephen's method of aldehyde synthesis

$$RCN \xrightarrow{HCl\ /\ SnCl_2\ /\ H_2O} RCHO$$

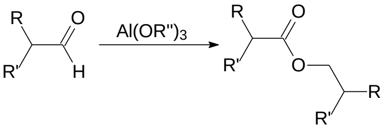
Note*: Can also be performed with lithium triethoxyaluminohydride, DIBAL-H or other reagents*

70. Schmidt Reaction



Note: *Aube reported intramolecular version: known as Schmidt-Aube reaction*

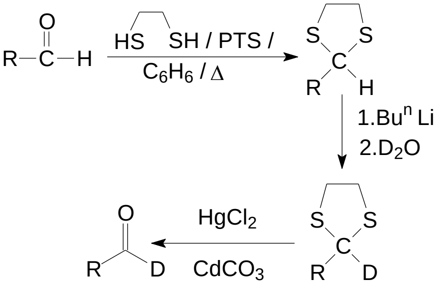
71. Tischenko reaction



Note: *Ester is prepared from aldehyde*

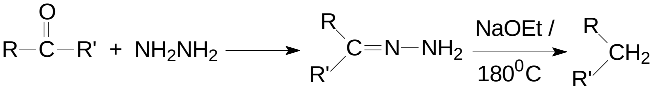
Note*: Other catalyst like boric acid can also be used*

72. Umpolung reaction (Corey-Seebach Reaction)



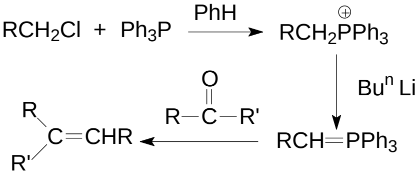
(Reversal of polarity of C-1)

73. Wolff-Kishner reduction



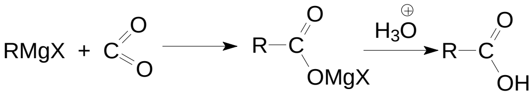
Note: *Unsuccessful with sterically hindered ketone*

74. Wittig reaction

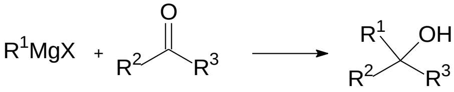


GRIGNARD/RELATED

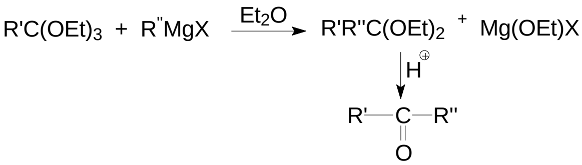
75. Preparation of an acid (Carbonation)

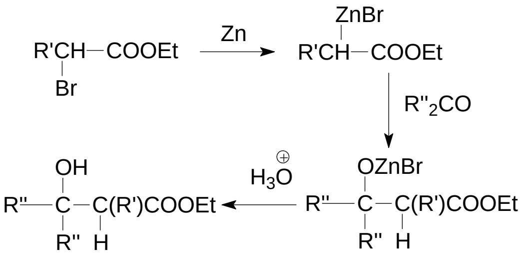


76. Grignard reaction

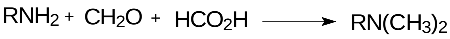
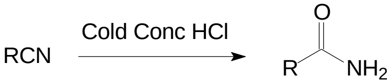
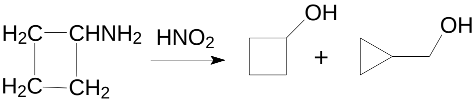
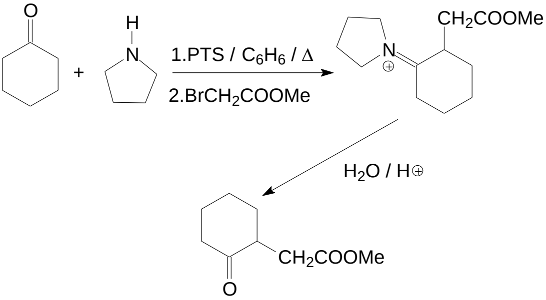


77. (Bodroux-Chichibabin synthesis)

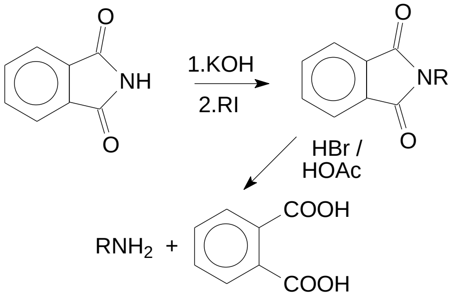


78.	**Reformatsky reaction**  *Note: Related reaction: Aza-Reformatsky reaction, nitrile Reformatsky reaction* *Note: Other metal catalyst can also be used*

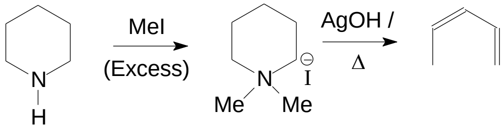
NITROGENEOUS COMPOUND

79.	**Clarke methylation (Eschweiler-Clarke reaction)**  ***Note:*** *Secondary amine can also be methylated by similar technique* ***Note:*** *Can be extended for N-alkylation of amide*
80.	**Conversion of Cyanide to amide**  ***Note***: *Other acid like TFA-H_2SO_4 can also be used*
81.	**Demjanov rearrangement** 
82.	**Cyclic Enamine formation and reaction**  ***Note:*** *Used or protection of carbonyl group followed by C-C bond formation*

83. **Gabriel synthesis**

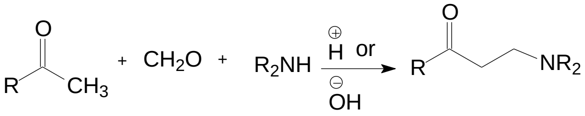


84. **Hofmann exhaustive methylation and elimination**



Note: Can be used to determine whether N is constituent of ring or not

85. **Mannich reaction**



86. **Hofmann rearrangement**

$$R{-}C({=}O){-}NH_2 \xrightarrow[KOH]{Br_2\,/\,H_2O\,/} RNH_2$$

87. **Methylation via CH_2N_2**

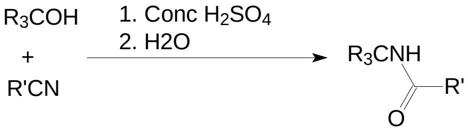
$$RCOOH + CH_2N_2 \xrightarrow{BF_3} RCOOCH_3$$

$$ROH + CH_2N_2 \xrightarrow{BF_3} ROCH_3$$

$$RNH_2 + CH_2N_2 \xrightarrow{BF_3} RNHCH_3$$

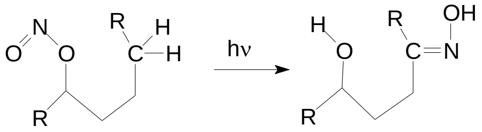
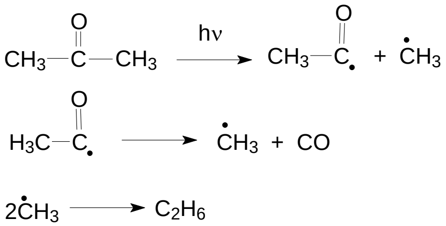
***Note**: Related reagent: trifluoromethyl diazomethane*

88. **Ritter reaction**

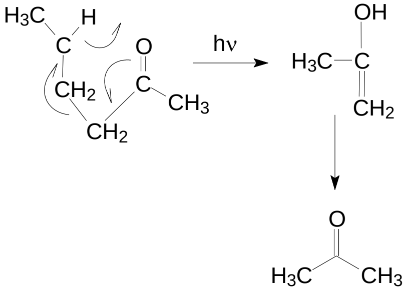


	Note: *Good method for preparation of amide*

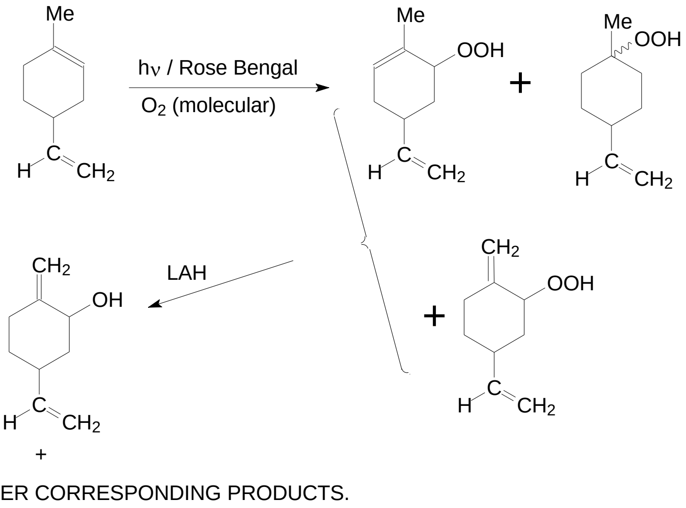
PHOTOCHEMISTRY

89.	**Barton reaction** 
90.	**Norrish type I Process** 

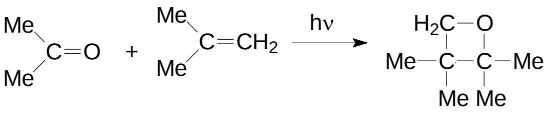
91. **Norrish type II Process**



92. **Oxidation with O_2 / rose Bengal / hν**



93. **Paterno-Buchi Reaction**



94. **Photo Chemical reduction of ketone to hydrol**

i) $Ph_2C{=}O \xrightarrow{h\nu} [Ph_2C{=}O]^{\star} [S_1] \longrightarrow [Ph_2C{=}O]^{\star} T_1$

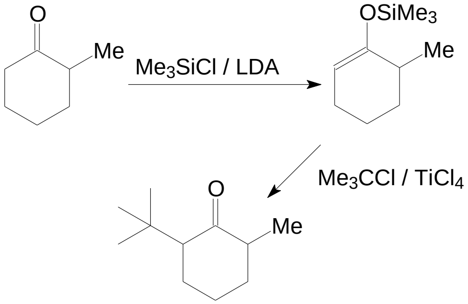
ii) $[Ph_2C{=}O]^{\star} [T_1] + Me_2CHOH \longrightarrow Me_2\dot{C}OH + Ph_2\dot{C}OH$

iii) $Me_2\dot{C}OH + Ph_2CO \longrightarrow Me_2CO + PH_2\dot{C}OH$

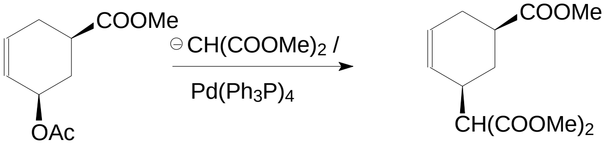
iv) $2Ph_2\dot{C}OH \longrightarrow Ph_2C(OH){-}C(OH)Ph_2$

ORGANOMETALIC CHEMISTRY

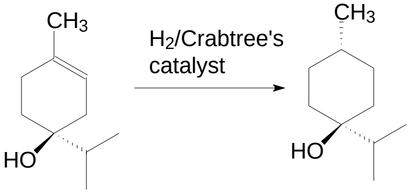
95. **Alkylation of cyclohexanone**



96. **Cis substitution of**



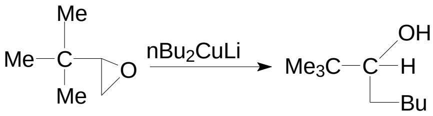
97. **Crabtree’s catalyst**



$[C_8H_{12}IrP(C_6H_{11})_3C_5H_5N]PF_6$
Crabtree's Catalyst

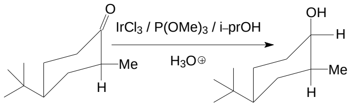
Note: *Advantage: effective for mono-, di-, tri-, and tetra-substituted alkenes*

98. Gilman reagent



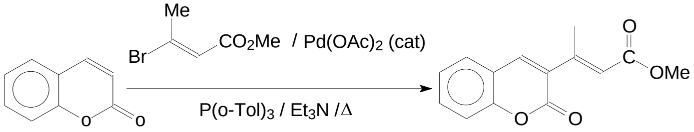
R_2CuLi: Gilman's reagent

99. Henbest reagent

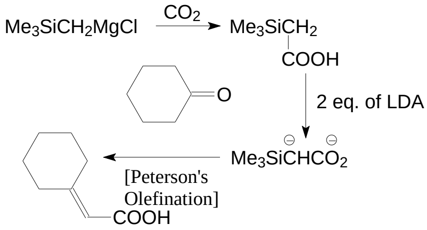


***Note**: By this process only axial alcohol can be produced*

100. Heck reaction(Heck coupling)

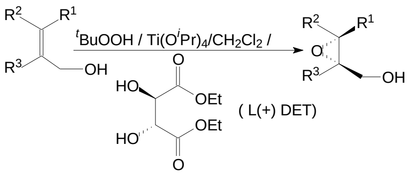


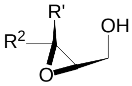
101. Peterson reaction (olefination)



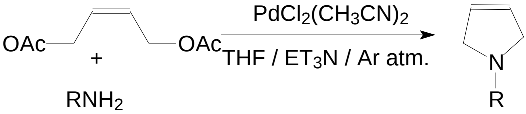
[In stead of CO_2^-, other substituents like alkyl groups can also be used]

102. Sharpless Asymmetric epoxidation

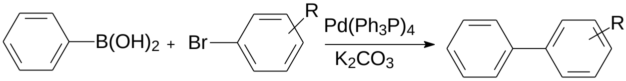


***Note:** If D(-) DET is used then*  *is the product.*

103. **Substitution at allylic position (Tsuji-Trost reaction)**

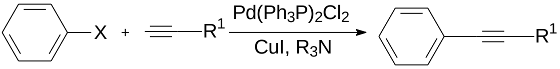


104. **Suzuki Coupling**



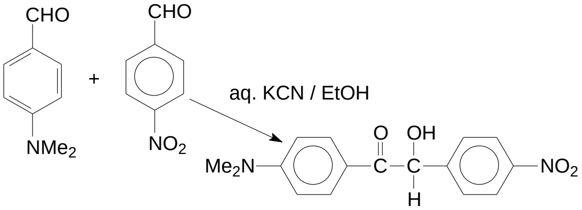
Note: *alkenyl and alkynyl compounds can also take place in similar reactions*

105. **Sonogashira Coupling**



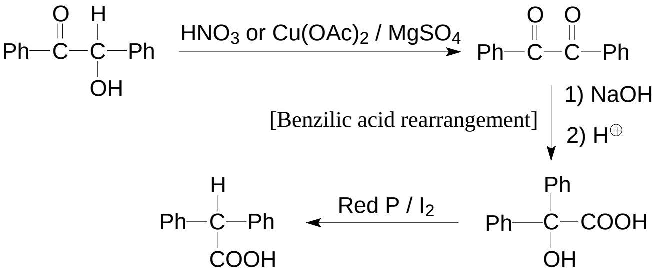
AROMATIC ALDEHYDES / KETONES

106. **Benzoin type condensation of substituted aromatic compounds**

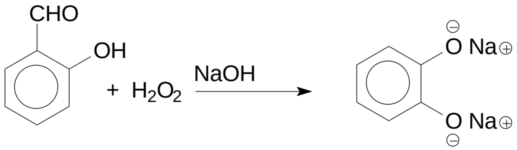


Note: *The product is called benzoin when substituents like dimethylamine or nitro groups are not present*

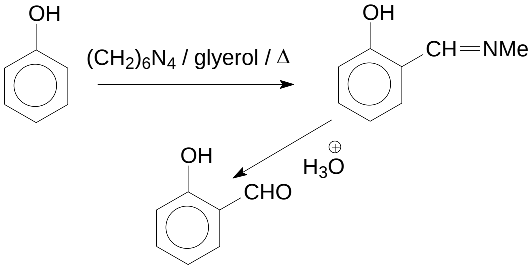
107. **Benzilic acid rearrangement formation**



108. **Dakin reaction**



109. **Duff’s reaction**



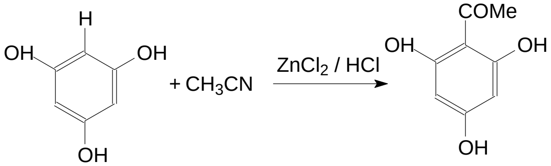
110. **Gatterman-Koch reaction**

$$C_6H_6 + CO + HCl \xrightarrow[AlCl_3]{} C_6H_5CHO$$

111. Gattermann aldehyde synthesis

$$C_6H_6 + HCl + HCN \xrightarrow{AlCl_3} C_6H_5CH{=}NH \xrightarrow{H_2O} NH_3 + C_6H_5CHO$$

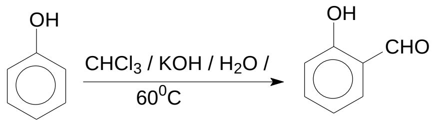
112. **Houben-Hosch synthesis**



113. **Perkin reaction**

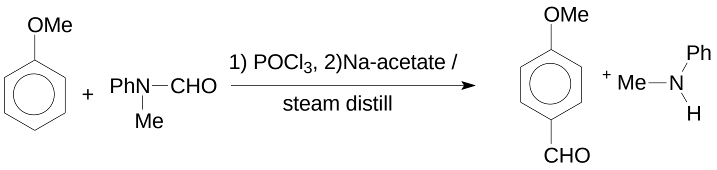
$$PhCHO \xrightarrow[MeCO_2Na/140\ ^0C]{(MeCO)_2O\ \ (excess)} PhCH{=}CHCO_2^{\ominus}$$

114. **Reimer-Tiemann reaction**



Note: *Formylation reaction takes place*

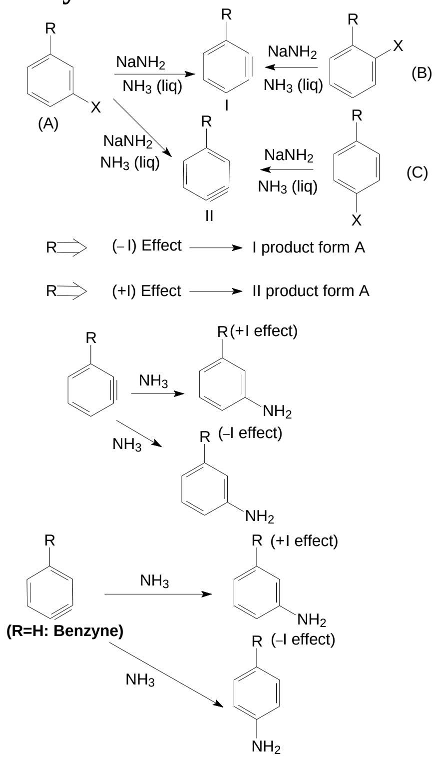
115. **Vilsmeier-Haack Reaction**



Note: *Formylation reaction takes place*

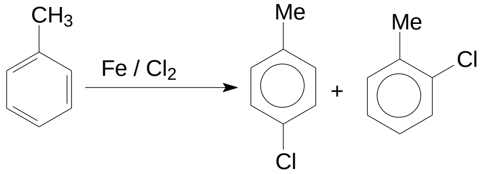
AROMATIC HALOGEN COMPOUND

116. **Benzyne: formation and reaction**



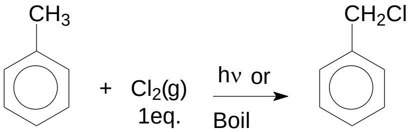
Note: *The entering group takes up a position adjacent to that occupied by the leaving group is called Cine-substitution*

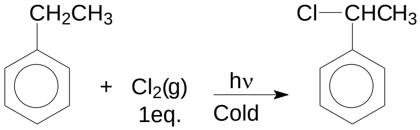
117. Halogenation on ring of toluene

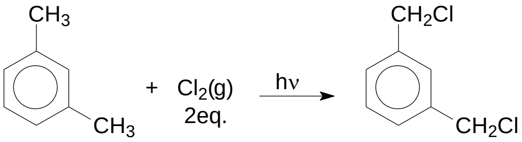


Note*: This is an Example of electrophilic reaction*

118. Halogenation on side chain of toluene

i)


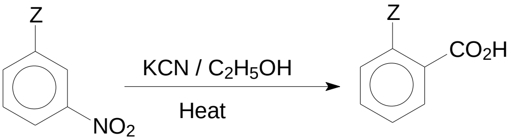
ii)


iii)


Note*: Reaction proceeds via free radical pathway*

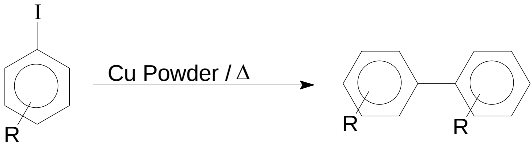
Note*: N-Bromosuccinimide can also be used*

119. Von-Richter reaction



Z= H, Br, Cl

120. Ullmann Biaryl synthesis

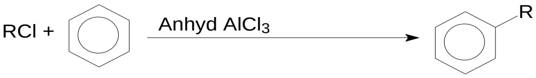


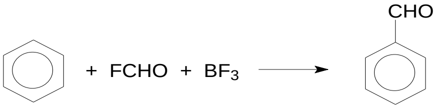
AROMATIC HYDROCARBONS

121. Blanc Chloromethylation

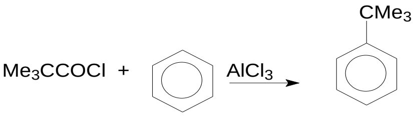
$$C_6H_6 + CH_2O + HCl \xrightarrow{ZnCl_2} C_6H_5CH_2Cl$$

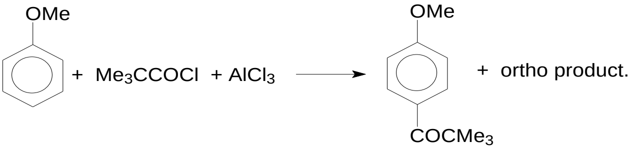
122. Fridel – Crafts reaction

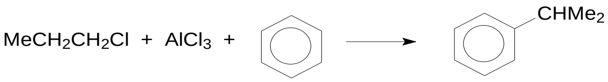
i)


ii)


HOCl can not be used for this purpose

III)a)


b)


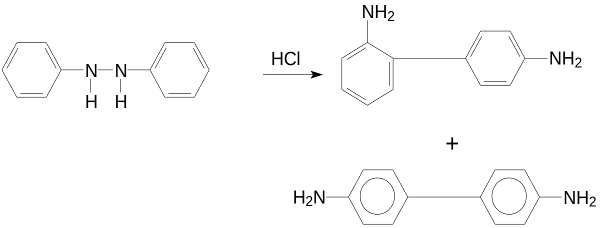
iv)


123. Wurtz- Fittig reaction

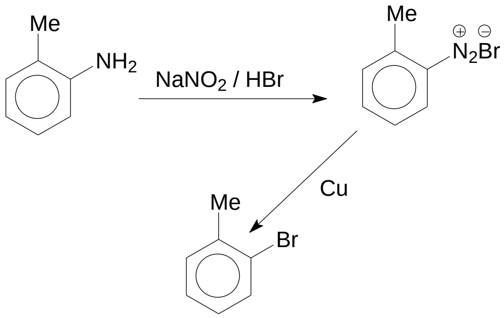
$$C_6H_5Br + C_2H_5Br + 2Na \longrightarrow C_6H_5C_2H_5 + NaBr$$

DIAZONIUM SALTS

124. Benzidine rearrangement

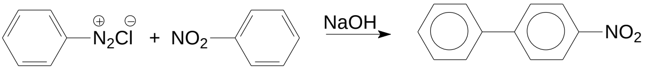


125. Gattermann Reaction for preparation of aryl halide

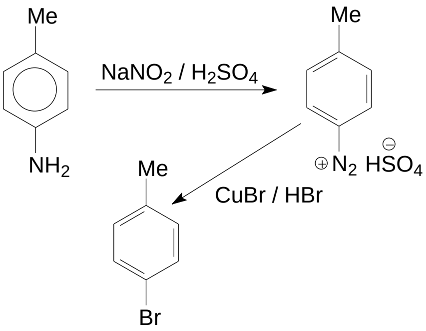


***Note**: Related reaction: Sandmeyer reaction*

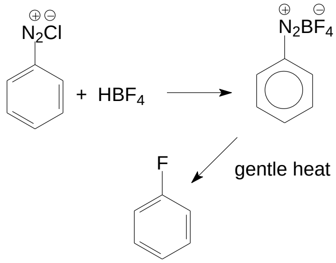
126. Gomberg-Bachmann reaction



127. Sandmeyer reaction

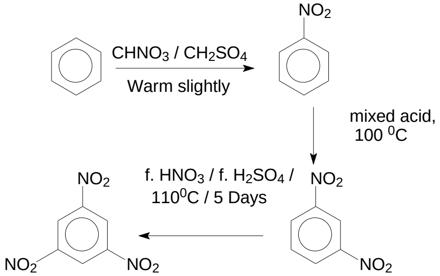


128. **Schiemann-Balz Reaction**



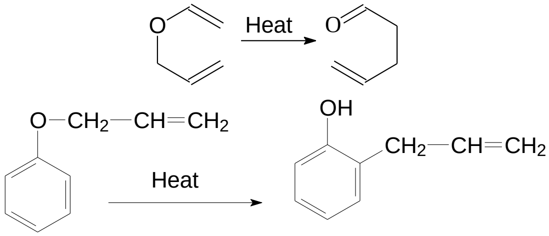
NITRO COMPOUNDS (AROMATIC)

129. **Multiple nitration of benzene**

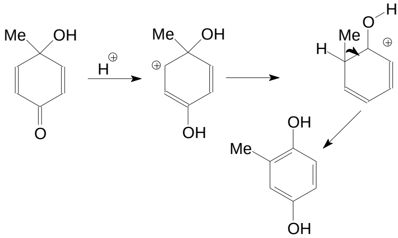


PHENOLS

130. **Claisen rearrangement**

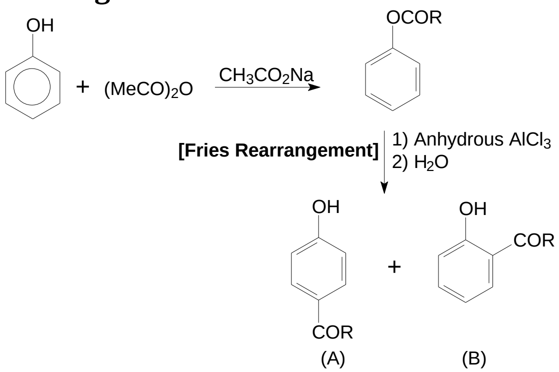


131. **Dienone - Phenol rearrangement**



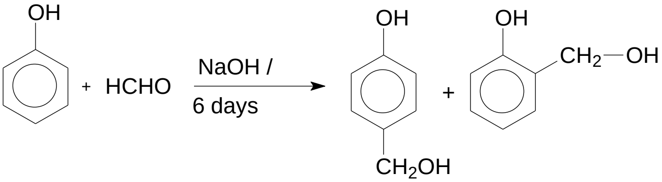
Note: Can be considered as reversal of pinacol rearrangement

132. **Fries rearrangement**

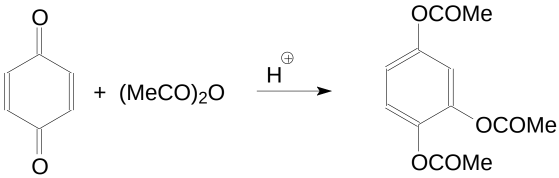


Note:***A*** *is major when (> 160^{0}C)/ AlCl$_3$.* ***B*** *is major when AlCl$_3$ /C$_6$H$_5$NO$_2$ / 25^{0}C*

133. **Lederer – Manasse Reaction**

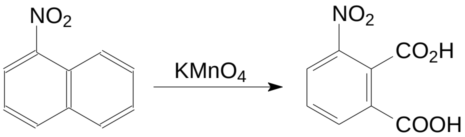


134. **Thiele acetylation**



POLYNUCLEAR HYDROCARBONS

135. **Oxidation of nitronapthalene**

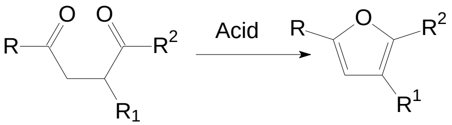


Note: *Ce(IV) can also be used*

HETEROCYCLIC COMPOUNDS

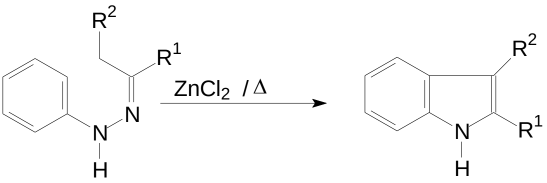
(FURAN)

136. **Paal-Knorr Furan Synthesis**

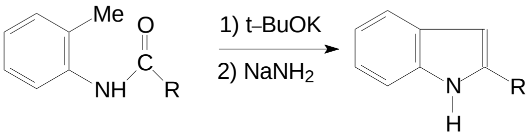


HETEROCYCLIC COMPOUNDS (INDOLE)

137. **Fischer – Indole Systhesis**

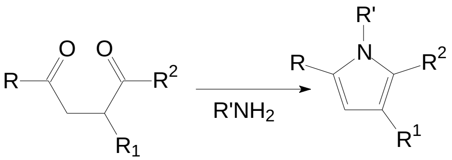


138. **Medelung synthesis**



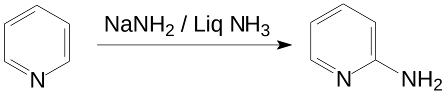
HETEROCYCLIC COMPOUNDS PYRROLE

139. **Paal-Knorr Pyrrole Synthesis**



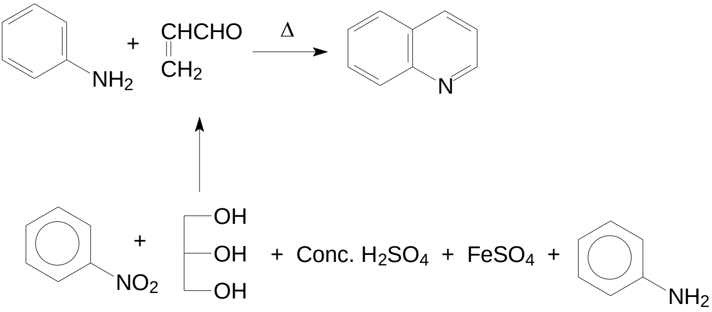
HETEROCYCLIC COMPOUNDS PYRIDINE

140. **Chichibabin reaction**



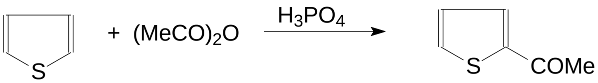
HETEROCYCLIC COMPOUNDS QUINOLINE

141. **Skraup synthesis**

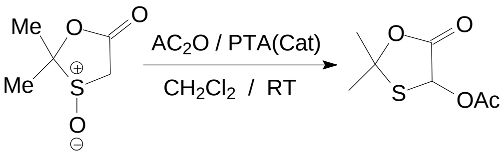


HETEROCYCLIC COMPOUNDS THIOPHENE

142. **Acetylation**



143. **Pummerer rearrangement**



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Sl. No.	**NAME**	**REFERENCES** Journal(Year)Page
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ALKANE		

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ALKENE		
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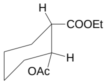
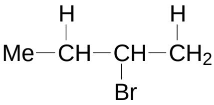
35.	**Pyrolysis of ester**  *(Heat mediated Conversion of esters containing beta-hydrogen into carboxylic acid)*	Chem. Commun.(2016)7858 J. Am. Chem. Soc.(1938)2419 Org. Syn. Coll. Vol. 4(1963)78
36.	**Saytzeff elimination**  **of** *(Formation of more stable alkenes containing internal double bonds by elimination reaction)*	RSC Adv.(2015)8297 Top. Catal.(2014)715 Angew. Chem. Int.(2009)5724 J. Mol. Catal.(1988)123
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44.	**Conversion to alddehyde / ketone** *(Promoted by boron reagent or mercury*	Synfacts(2016)0116 Angew.Chem. Int(2013)14300 J. Am.Chem. Soc(2008)16460 Synthesis(1980)151 Tetrahedron Lett.(1973)673

	reagent)	
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52.	**Claisen-Schmidt Condensation** *(Reaction between aldehyde or ketone and aromatic carbonyl compound lacking an alpha-hydrogen)*	Nanoscale(2014)1596 J. Org. Chem.(2007)8489 J. Am. Chem. Soc.(2004)3396 Pure Appl. Chem.(1996)539 J. Org. Chem.(1991)1882
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	to a carbonyl group followed by dehydration reaction is called Knoevenagel reaction)	J. Org. Chem.(2002)9443
59.	**Lossen reaction (Rearrangement) And application** *(Conversion of hydroxamic acid to isocyanate via the formation of O-acyl (or other) is called Lossen reaction)*	Org. Biomol. Chem.(2016)9046 J. Org. Chem.(2015)180 Adv. Synth. Catal.(2013)81 Angew. Chem. Int.(1974)376 Chem. Rev.(1934)219
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64.	**Protection of ketone followed by deprotection**	J. Org. Chem.(2016)6883 J. Org. Chem.(2015)2733 Synthesis(2010)1493 J. Org. Chem.(2001)7527 J. Org. Chem.(1991)2317
65.	**Rosenmund reaction** *(Synthesis of aldehyde from acid chloride)*	Org. Process Res. Dev.(2016)1246 Org. Process Res. Dev.(1997)226 J. Am. Chem. Soc.(1986)2608 J. Chem. Soc.(1962)2024
66.	**Robinson annulation** *(Combination of Michael addition and Aldon condensation to produce a six membered ring in polycyclic compound is known as Robinson Annulation)*	J. Am. Chem. Soc.(2016)7536 Angew. Chem. Int.(2015)8538 J. Org. Chem.(2016)10172 J. Chem. Edu.(2008)1534 Angew. Chem.(1996)2830
67.	**Reduction of cyclo hexanone to produce equatorial alcohol**	J. Chem. Soc.Dalton(2015)4693 Tetrahedron(2004)3465 J. Org. Chem.(1997)6164 J. Chem. Soc.Perkin(1993)1009 J. Am. Chem. Soc.(1987)5875 J. Am. Chem. Soc.(1981)4540
68.	**Cyclohexanone reduction to produce axial Alcohol**	J. Org. Chem.(2014)11609 Chem. Rev.(1999)1387 J. Am. Chem. Soc.(1989)8447
69.	**Stephen's method of aldehyde synthesis**	Tetrahedron Lett.(2011)6058 J. Org. Chem.(1981)602 J. Am. Chem. Soc.(1964)1085 J. Am. Chem. Soc.(1939)2248
70.	**Schmidt Reaction** *(Reaction of azide with a carboxylic acid to form amine or reaction of azide with carbonyls to form azide is known as Schmidt reaction)*	J. Am. Chem. Soc.(2016)969 J. Org. Chem.(2016)9372 Synlett(2012)2627 Chem. Soc. Rev.(2006)146 J. Am. Chem. Soc.(1991)8965

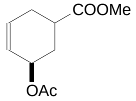
71.	**Tischenko reaction** *(Disproportionation of an aldehyde lacking alpha-H to produce an ester is known as Tischenko reaction)*	Org. Lett.(2016)5692 J. Chem. Soc. Dalton(2016)4896 J. Am. Chem. Soc.(2011)4668 Org. Lett.(2007)2791 J. Org. Chem.(1973)1433
72.	**Umpolung reaction (Corey-Seebach** *(Umpolung Reaction: Polarity inversion) (Use of lithiated 1,3-dithianes as nucleophilic acylating agent is knows as Corey-Seebach reaction)*	J. Org. Chem.(2016)12128 J. Chem. Edu.(2016)1470 J. Org. Chem.(2015)9132 J. Am. Chem. Soc.(2006)66 J. Org. Chem.(1999)6804 J. Am. Chem. Soc.(1985)4339 J. Am. Chem.Soc.(1984)2949
73.	**Wolff-Kishner reduction** *(Reduction of aldehyde or ketone to alkane via the formation of hydrazone is known as Wolff-Kishner reduction)*	J. Chem. Edu.(2016)949 Org. Lett.(2009)4164 J. Am. Chem. Soc.(2004)5436 J. Org. Chem.(1988)477 Can. J. Chem.(1979)3348 J. Org. Chem.(1977)1081 Angew. Chem.Int(1968)120 J. Am. Chem. Soc.(1945)2061
74.	**Wittig reaction** (*Preparation of alkene from aldehyde or ketone by the use of phosphorous-ylide is called Wittig reaction)*	Organic Lett.(2016)6292 J. Chem. Edu.(2016)1636 J. Am. Chem. Soc.(2010)5018 J. Am. Chem. Soc.(2004)706 J. Am. Chem. Soc.(1993)9293
GRIGNARD/RELATED		
75.	**Preparation of an acid (Carbonation)**	Angew. Chem.Int.(2009)6201 Chem. Rev.(2007)2365 J.Radioanal.Nucl.Chem.(2000)635 J. Am. Chem. Soc.(1951)1364
76.	**Grignard reaction** *(Addition of alkyl/aryl magnesium bromide to carbonyl group is known as Grignard reaction)*	J. Chem. Edu.(2016)1464 Nature Commun.(2016)13780 j. Org. Chem.(2012)4645 Org. Lett.(2008)1999 J. Am.Chem. Soc(2005)11958 J. Chem. Edu.(1999)1427

77.	**(Bodroux-Chichibabin synthesis)** *(Conversion of an aldehyde to another aldehyde of one carbon longer by Grignard reagent)*	Tetrahedron Lett.(1982)3361 J. Am. Chem. Soc.(1953)3697 J. Org. Chem.(1941)437
78.	**Reformatsky reaction** *(Addition of organozinc compound to form hydroxyester)*	Org. Biomol. Chem.(2016)9896 Chem. Eur. J.(2016)17590 Synthesis(2015)79 Org. Lett.(2015)5428 J. Org. Chem.(2013)10588 E. J. Org. Chem.(2013)7028 Chem. Soc. Rev.(2013)937 J. Org. Chem.(2006)3332 Synthesis(1989)571
NITROGENEOUS COMPOUND		
79.	**Clarke methylation (Eschweiler-Clarke reaction)** *(Methylation of a primary amine using excess formic acid and formaldehyde)*	Chem. Sci.(2016)4685 Chem. Eur. J.(2011)6221 Tetrahedron Lett.(1994)3313 Tetrahedron Lett.(1991)3847 J. Am. Chem. Soc.(1964)3162 J. Am. Chem. Soc.(1933)4571
80.	**Conversion of Cyanide to amide**	J. Org. Chem.(2005)1926 Platinum metals rev.(1996)169
81.	**Demjanov rearrangement** *(Involves the rearrangement of primary cyclic amine to produce alcohol by nitrous acid)*	Org. Lett.(2008)5247 Tetrahedron(1993)1649 J. Org. Chem.(1965)1840 J. Org. Chem.(1965)350 Can. J. Chem.(1965)3433
82.	**Cyclic Enamine formation and reaction** *(Enamine is an unsaturated compound formed by the reaction of aldehyde/ketone*	RSC Adv.(2016)14763 Chem. Eur. J.(2015)3443 Eur. J. Org. Chem.(2012)4881 Tetrahedron Lett.(2004)5921 J. Chem. Edu.(1966)665 J. Chem. Edu.(1963)194

	with secondary amine)	
83.	**Gabriel synthesis** *(Preparation of primary amine by the reaction of alkyl halide)*	RSC Adv.(2014)34764 J. Electroanal. Chem.(2012)127 Synthesis(1995)756 Acc.Chem.Res.(1991)285 J. Chem. Edu.(1975)670 Angew.Chem.Int.(1968)919
84.	**Hofmann exhaustive methylation and elimination** *(Is a process where a quaternary amine is formed followed by the formation of alkene)*	Polym. Chem.(2016)2464 Syn. Commun.(2012)3545 Langmuir(2002)3767 J. Chem. Edu.(1968)547 J. Pharm. Sci.(1961)888
85.	**Mannich reaction** *[Preparation of aminoalkylated product from primary/secondary amine, formaldehyde and keto compound (enolizable or potentially enolizable)]*	J. Am. Chem. Soc.(2016)3659 J. Chem. Edu.(2015)1103 Synthesis(2015)1280 J. Org. Chem.(2006)4222 Tetrahedron Lett.(2004)8335 Angew. Chem.Int.(2003)3677 Angew.Chem. Int.(1998)1044
86.	**Hofmann rearrangement** *(Formation of primary amine with one fewer carbon from an amide)*	Org. Lett(2016)5572 Org. Lett.(2014)6244 Angew.Chem.Int.(2007)5734 Org. Lett.(2001)3009 J. Chem. Edu.(1999)1717
87.	**Methylation via CH_2N_2**	J. Org. Chem.(2016)5814 Org. Lett.(2016)3406 J. Pept. Sci.(2015)644 Eur.J.Org.Chem.(2013)5731 J. Org. Chem.(2007)4798
88.	**Ritter reaction** *(Conversion of nitrile to N-alkyl amide using electrophilic alkylating agent)*	Eur. J. Org. Chem.(2016)1414 J. Org. Chem.(2009)2207 Tetrahedron Lett.(2003)1453 J. Chem. Edu.(2002)484 J. Am. Chem. Soc.(1948)4045

PHOTOCHEMISTRY

89.	**Barton reaction** *(Photochemical reaction involving the photolysis of an alkyl nitrite to form an oxime)*	Org. Bioomol. Chem.(2016)6225 Tetrahedron(2009)1593 Org. Biomol. Chem.(2003)2461 J. Am. Chem. Soc.(1964)265 J. Am. Chem. Soc.(1960)2640
90.	**Norrish type I Process** *(Photochemical hemolytic cleavage of aldehydes or ketones to form two free radical intermediate)*	Adv. Chem. Phys.(2016)1 J. Polym. Sci.A(2016)473 Angew. Chem. Int.(2015)12612 J. Am. Chem. Soc.(1970)6974 J. Org. Chem.(2008)6711
91.	**Norrish type II Process** *(Photochemical reaction involving the intramolecular abstraction of gamma-hydrogen by the carbonyl group causing the cyclization of the resulting biradicals)*	Dyes Pigm.(2017)456 Chem. Eur. J.(2014)2671 J. Am. Chem. Soc.(2012)1115 Angew. Chem. Int.(2008)8917 J. Org. Chem.(1999)1626 J. Chem. Edu.(1988)832
92.	**Oxidation with O_2 / rose Bengal / hν** *(Production of singlet oxygen by rose Bengal)*	ChemPhysChem(2016)270 Phys. Chem. Chem. Phys.(2015)26307 ChemSusChem(2015)1648 Org. Chem. Front.(2014)551 Angew. Chem. Int.(1996)477 Tetrahedron(2000)1595 Acc. Chem. Res.(1980)419
93.	**Paterno-Buchi Reaction** *([2+2] cycloaddition of keto compounds with olefins to give an oxetane)*	Acc. Chem. Res.(2016)2713 J. Chem. Edu.(2015)1716 Synthesis(2009)4268 Chem. Commun.(1997)2381 J. Am. Chem. Soc.(1994)2121
94.	**Photo Chemical reduction of ketone to hydrol**	J. Am. Chem. Soc.(1958)2913 J. Am. Chem. Soc.(1933)391

ORGANOMETALIC CHEMISTRY		
95.	**Alkylation of cyclohexanone**	J. Org. Chem.(2016)10204 Adv. Synth. Catal.(2013)2651 Tetrahedron(2001)583 J. Org. Chem.(1976)3063
96.	**Cis substitution of**  *(Stereoselective Allylic alkylation)*	J. Am. Chem. Soc.(2016)15869 Catal. Commun. (2013) 94 J. Org. Chem.(2004)4041 J. Am. Chem. Soc.(1992)6858 J. Am. Chem. Soc.(1980)4730
97.	**Crabtree's catalyst**	J. Am. Chem. Soc.(2016)11930 Acc. Chem. Res.(2016)1232 Acc. Chem. Res.(2014)1174 Chem. Commun.(2008)199 J. Org. Chem.(2005)5197 Angew. Chem.Int.(1987)190
98.	**Gilman reagent**	J. Organomet. Chem.(2016)259 RSC Adv.(2014)14468 Tetrahedron Lett.(2015)2656 Tetrahedron(2013)8618 J. Am. Chem. Soc.(2013)9656
99.	**Henbest reagent**	Tetrahedron(1999)3255 J. Chem. Soc.C(1970)785 J. Chem. Soc.C(1969)1653 Tetrahedron Lett.(1961)404
100.	**Heck reaction (Heck coupling)** *(The palladium-catalyzed C-C coupling of aryl/vinyl halides and activated alkenes)*	J. Organomet. Chem.(2017)56 Synlett(2015)619 J. Org. Chem.(2009)4882 J. Am. Chem. Soc.(2003)3090 Chem. Rev.(2000)3009 J. Org. Chem.(1972)2320
101.	**Peterson reaction (olefination)** *(Formation of alkenes from alpha-silylcarbanions)*	Tetrahedron(2016)472 Eur. J. Org. Chem.(2015)7259 Chem. Eur. J.(2015)8737 J. Org. Chem.(2014)1145 Synlett(2006)2577 Synlett(2003)414 Tetrahedron Lett.(1988)3283

102.	**Sharpless Asymmetric epoxidation** *(Enantioselective epoxidation of prochiral allylic alcohol using an enatiomerically pure tartarate derivative)*	J. Org. Chem.(2016)9567 Angew. Chem. Int.(2016)13263 Tetrahedron Lett.(2016)861 Angew. Chem.Int.(2010)6673 J. Am. Chem. Soc.(1991)113 Synthesis(1986)89 J. Am. Chem. Soc.(1980)5974
103.	**Substitution at allylic position (Tsuji-Trost reaction)** *(Palladium catalyzed substitution of leaving group in allylic position)*	J. Mat. Chem.(2015)2609 J. Am. Chem. Soc.(2013)12536 J. Org. Chem.(2009)3982 Angew. Chem. Int.(2008)3759 Chem. Rev.(1996)395
104.	**Suzuki Coupling** *(Palladium catalyzed cross-coupling reaction between organoboronic acid and halide)*	Tetrahedron Lett.(2017)666 Green Chem.(2016)2363 J. Am. Chem. Soc.(2014)14027 Org. Lett.(2008)1999 Synthesis(2007)393
105.	**Sonogashira Coupling** *(Palladium catalyzed coupling reaction of alkynes with aryl or vinyl halides)*	Eur. J. Org. Chem.(2017)955 Org. Biomol. Chem.(2017)1510 Chem. Eur. J.(2016)7179 Synlett(2008)1657 Tetrahedron(1990)458

AROMATIC ALDEHYDES / KETONES

106.	**Benzoin type condensation of substituted aromatic compounds** *(Formation of alpha-hydroxyketones from the coupling reaction of two aromatic aldehydes)*	J. Org. Chem.(2016)12075 Chem. Eur. J.(2015)18033 J. Org. Chem.(2014)2481 Tetrahedron(2014)5739 J. Am. Chem. Soc.(2014)7359 J. Chem. Edu.(2004)1020 J. Org. Chem.(2009)9214
107.	**Benzilic acid rearrangement formation**	Chem. Commun.(2016)108 Tetrahedron(2015)3705 J. Org. Chem.(2006)1777 Green Chem.(2005)800 Synlett(1995)35

	(Rearrangement of aromatic 1,2-diketones in presence of a base to produce aromatic alpha-hydroxycarboxylic acid)	J. Org. Chem.(1991)6709
108.	**Dakin reaction** *(Preparation of phenols from aromatic ortho/para hydroxylated aldehydes/ketones)*	Green Chem.(2015)4533 Org. Lett.(2012)2806 Eur. J. Org. Chem.(2009)2130 J. Org. Chem.(1984)4740 J. Org. Chem.(1982)4208
109.	**Duff's reaction** *(Formylation reaction to produce aromatic aldehyde using hexamine)*	Org. Biomol. Chem.(2016)10496 Org. Biomol. Chem.(2016)7046 J. Org. Chem.(2008)5992 J. Am. Chem. Soc.(2005)11958 Tetrahedron(1968)5001
110.	**Gatterman-Koch reaction** *(Friedel-Crafts acylation reaction to produce an aromatic aldehyde)*	Tetrahedron Lett.(2014)3909 J. Org. Chem.(1998)4412 J. Am. Chem. Soc.(1997)5100 J. Am. Chem. Soc.(1949)1263
111.	**Gattermann aldehyde synthesis** *(Catalytic formylation of aromatic compounds using hydrogen cyanide)*	Chem. Eng. J.(2017)1577 Tetrahedron Lett.(2011)5170 Org. Lett.(2011)4344 Tetrahedron(2011)4494 J. Am. Chem. Soc.(1923)2373
112.	**Houben-Hosch synthesis** *(Formation of aryl ketone by the reaction of nitrile compounds with arenes)*	Tetrahedron(2016)1461 Chem. Asian J.(2015)553 Synth. Commun.(2014)3296 Eur. J. Org. Chem.(2013)1356 Org. Lett.(2013)528
113.	**Perkin reaction** *(Formation of alpha, beta-unsaturated aromatic acid by aldol condensation of an aromatic acid and acid anhydride)*	New J. Chem.(2016)113 Arkivov(2016)242 Tetrahedron(2003)3351 J. Chem. Edu.(1963)A139 J. Org. Chem.(1950)451
114.	**Reimer-Tiemann reaction** *(A base-promoted chemical reaction which can be used to convert a phenolic compound to an o-*	Catal. Lett.(2015)712 Synth. Commun.(2011)476 Org. Biomol. Chem.(2011)5109 Org. Lett.(2007)1367 Chem. Rev.(1960)169

	hydroxy benzaldehyde-type compound)	
115.	**Vilsmeier-Haack Reaction** *(Formation of an aryl aldehyde/ketone from electron-rich arene by phosphorous oxychloride and substituted amide)*	J. Org. Chem.(2016)9247 RSC Adv.(2016)59375 J. Org. Chem.(2008)9504 Org. Lett.(2007)2421 J. Org. Chem.(2007)8593 J. Am. Chem. Soc.(1999)6771
AROMATIC HALOGEN COMPOUND		
116.	**Benzyne: formation and reaction**	Chem. Soc. Rev.(2016)6766 J. Am. Chem. Soc.(2016)10402 Org. Lett.(2016)6324 J. Org. Chem.(2016)5921 Tetrahedron(2001)1639
117.	**Halogenation on ring of toluene**	Angew. Chem. Int.(2016)7848 Acc. Chem. Res.(2016)1191 React. Chem. Eng.(2017)7 Adv. Synth. Catal.(2014)2453
118.	**Halogenation on side chain of toluene**	Tetrahedron Lett.(2006)1097 J. Chem. Soc.Perkin(2000)2745 J. Org. Chem.(1997)236 J. Chem. Edu.(1980)507 Synthesis(1973)1 J. Phys. Chem.(1957)104
119.	**Von-Richter reaction** *(Cine-substitution reaction of aromatic nitro compound to produce aromatic carboxylic acid using cyanide compound)*	Mendeleev Commun.(2015)41 J. Am. Chem. Soc.(2006)27 J. Org. Chem.(1963)3240 J. Am. Chem. Soc.(1960)3796 J. Org. Chem.(1956)944
120.	**Ullmann Biaryl synthesis** *(Coupling reaction between aryl halides and copper to prepare biaryl compounds)*	Synlett(2016)859 Tetrahedron(2016)5994 J. Org. Chem.(2008)7814 Chem. Commun.(2005)2849 Chem. Rev.(1946)139

AROMATIC HYDROCARBONS		
121.	**Blanc Chloromethylation** *(Zinc chloride catalyzed chloromethylation of aromatic compounds using formaldehyde and hydrogen chloride)*	J. Am. Chem. Soc.(1999)7804 Chin. J. Chem. Eng.(2008)357 Res. Chem. Intermediat(2015)6393 J. Chem. Res.(2014)408
122.	**Fridel – Crafts reaction** *(Alkylation of acylation of aromatic ring using a strong Lewis acid)*	Can. J. Chem.(2017)16 Org. Lett.(2016)3534 Org. Lett.(2014)1096 Synthesis(2010)2835 J. Chem. Edu.(1979)480 Can. J. Chem.(1979)3348 J. Chem. Edu.(1963)214 J. Am. Chem. Soc.(1953)5032
123.	**Wurtz- Fittig reaction** *(Preparation of substituted aromatic compounds from aryl halide and alkyl halide by sodium metal)*	Tetrahedron Lett.(2016)3231 J. Indian Chem. Soc.(2012)287 Synlett(2010)3008 J. Org. Chem.(2007)8107 J. Am. Chem. Soc.(1933)2893
DIAZONIUM SALTS		
124.	**Benzidine rearrangement** *(The acid catalyzed rearrangement of hydrazobenzene into benzidine)*	Tetrahedron(2016)3151 Org. Biomol. Chem.(2014)4952 Tetrahedron Lett.(2014)3950 Angew. Chem.Int.(2013)9463 Eur. J. Org. Chem.(2011)2326
125.	**Gattermann Reaction for preparation of aryl halide** *(Formation of aryl halides by the treatment of freshly prepared diazonium salt solution with copper powder in presence of*	Chem. Eng. J.(2017)1577 Chem. Eng. Technol.(2016)1445 Chem. Rev.(1947)251 J. Chem. Soc.(1942)266

	corresponding halogen acid)	
126.	**Gomberg-Bachmann reaction** *(Base-catalyzed coupling of arene compounds with diazonium salts to produce biaryl compound)*	Org. Lett.(2016)6078 Chem. Eur. J.(2012)11555 J. Org. Chem.(1984)1594 J. Org. Chem.(1965)2451 J. Am. Chem. Soc.(1924)2339
127.	**Sandmeyer reaction** *(Formation of diazonium salt from aromatic amine followed by subsequent displacement with a nucleophile (halide, pseudohalide etc)*	Chem. Eu. J.(2016)2620 J. Org. Chem.(2016)11611 Org. Lett.(2008)1999 Synthesis(2007)2534 J. Am. Chem. Soc.(2005)15038 Chem. Rev.(1947)251
128.	**Schiemann-Balz Reaction** *(Formation of aryl fluorides from aromatic amine via the formation of diazonium salts)*	Angew. Chem. Int.(2016)12086 Chem. Rev.(2015)566 Tetrahedron Lett.(2013)1261 J. Chem. Res. (s)(1995)460 J. Am. Chem. Soc.(1975)799
NITRO COMPOUNDS (AROMATIC)		
129.	**Multiple nitration of benzene**	Phys. Chem. Chem. Phys.(2016)11722 Angew. Chem.Int.(2010)1726 Angew. Chem.Int.(2010)958 J. Org. Chem.(2006)6192 J. Chem. Edu.(1982)689 J. Am. Chem. Soc.(1946)1871
PHENOLS		
130.	**Claisen rearrangement** *(Sigmatropic rearrangement of allyl vinyl ether to* γ,δ*–unsaturated*	Angew. Chem. Int.(2016)4122 Chem. Eur. J.(2016)3709 Tetrahedron Lett.(2016)4053 J. Org. Chem.(2015)1472 Org. Lett.(2005)4205 J. Am. Chem. Soc.(1979)6768

	compound. For allyl aryl ether, it is accompanied by rearomatization to form a phenolic compound)	
131.	**Dienone - Phenol rearrangement** *(Rearrangement reaction of 6-membered cyclic dienones to generate phenols)*	Org. Lett.(2016)4324 RSC Adv.(2015)38499 Tetrahedron(2013)9609 Steroids(1998)135 Tetrahedron Lett.(1963)1671 J. Am. Chem. Soc.(1947)2322
132.	**Fries rearrangement** *(Lewis acid-catalyzed rearrangement of phenolic ester to hydroxyl aryl ketones)*	Science(2016)691 J. Org. Chem.(2016)10687 Synlett(2012)1927 Tetrahedron Lett.(2001)1979 J. Catal.(1998)260 Tetrahedron Lett.(1990)4443
133.	**Lederer – Manasse Reaction** *(Conversion of phenols into hydroxybenzalcohol)*	J. Heterocyclic Chem.(2014)1679 Polym. Int.(2014)1842 Eur. J. Med. Chem.((2013)329
134.	**Thiele acetylation** *(Reation of quinones with acetic anhydride to produce triacetoxy compound)*	Eur. J. Org. Chem.(2013)5731 Chemistry Lett.(1977)627 J. Chem. Soc.(1952)755
POLYNUCLEAR HYDROCARBONS		
135.	**Oxidation of nitronapthalene** *(3-nitrophthalic acid is the principal product for the oxidation of alpha-nitronaphthalene by various agents)*	Green Chem.(2002)210 J. Am. Chem. Soc(1927)1831 Ann(1880)217

HETEROCYCLIC COMPOUNDS (FURAN)		
136	**Paal-Knorr Furan Synthesis** *(Cyclization of 1,4-dicarbonyl compound to produce furan)*	RSC Adv.(2016)33462 Org. Lett.(2015)1557 Eur. J. Org. Chem.(2005)5277 J. Org. Chem.(2003)5392 Org. Lett.(2000)2467
HETEROCYCLIC COMPOUNDS (INDOLE)		
137	**Fischer – Indole Systhesis** *(Acid promoted cyclization of aryl hydrazones to produce indole)*	Tetrahedron Lett.(2016)5605 Org. Lett.(2012)6112 J. Am. Chem. Soc.(1998)6621 J. Am. Chem. Soc.(1981)5599 Chem. Rev.(1963)373
138	**Medelung synthesis** *(Intramolecular cyclization of phenyl amide to produce indole)*	Tetrahedron Lett.(2013)6858 J. Am. Chem. Soc.(2003)8828 J. Org. Chem.(1981)4511
PYRROLE		
139	**Paal-Knorr Pyrrole Synthesis** *(Condensation of 1,4-dicarbonyl compound with*	Eur. J. Org. Chem.(2016)31 Tetrahedron(2016)4676 Chem. Commun.(2013)558 Synlett(2009)2245 Eur. J. Org. Chem.(2005)5277

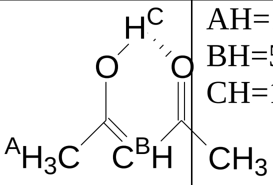
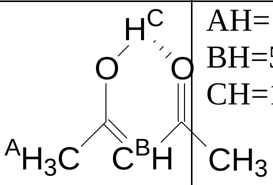
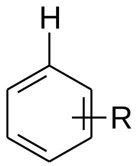
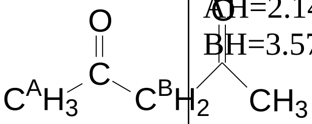
	primary amine to produce pyrrole)	
PYRIDINE		
140	**Chichibabin reaction** *(Reaction of pyridine with sodium amide to produce 2-aminopyridine)*	Tetrahedron Lett.(2016)333 Catal. Lett.(2015)947 J. Ind. Chem. Soc.(2013)1829 Tetrahedron Lett.(2001)6811 Adv. Heterocycl. Chem.(1988)1

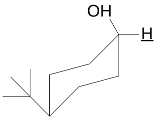
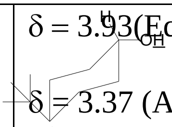
QUINOLINE		
141.	**Skraup synthesis** *(Synthesis of quinolone from aniline, glycerol and sulfuric acid)*	Green Chem.(2016)4064 Tetrahedron Lett.(2015)6436 Tetrahedron Lett.(2014)3319 Catal. Commun.(2014)15 Chem. Rev.(1942)113
THIOPHENE		
142.	**Acetylation**	J. Heterocyclic Chem.(2014)586 J. Ind. Chem. Soc.(2005)398 Synlett(2003)247 J. Am. Chem. Soc.(1947)3093
143.	**Pummerer rearrangement** *(Rearrangement of an alkyl sulfoxide to an alpha-acyloxy-thioether)*	Chem. Eur. J.(2016)6262 Synlett(2002)851 Synthesis(1997)1353 Tetrahedron Lett.(1984)4681

^{1}H NMR FREQUENCY

Tips : Shielding : (+) sign, Low δ value

Type of proton	**Chemical shift (δ) value(ppm)**
Cyclopropane ($C_3\underline{H}_6$)	0.2
$C\underline{H}_4$	0.23
$RC\underline{H}$	0.9
$R_2C\underline{H}$	1.2
$R_3C\underline{H}$	1.5
$ArC\underline{H}$	2.2-3
$IC\underline{H}$	2-4
$BrC\underline{H}$	2.5-4
$ClC\underline{H}$	3-4
$FC\underline{H}$	4-4.5
$HOC\underline{H}$	3.4-4
$ROC\underline{H}$	3.3-4
$C\underline{H}CO_2R$	2-2.2
$C\underline{H}CO_2H$	2-2.6
$C\underline{H}_2{=}CH_2$	5.84 (Cis coupling: J=7-8 Hz Trans coupling: J~17 Hz)
$C\underline{H}{\equiv}CH$	2.88
$O\text{-}\underline{H}$	4-5 (position varies)
$C\underline{H}Cl_3$	7.26
Type of proton	Chemical shift (□) value(ppm)
C=C-OH	15-16

Phenol (intra molecular H–bond)	10.5-12.5
	AH=1.97 BH=5.15 CH=14.92
	AH=1.97 BH=5.15 CH=14.92
	6-8.5 Ortho-coupling J ~7-8 Hz Meta-coupling J ~2 Hz Para-coupling J = 0 Hz
C≡CH	2-3
	AH=2.14 BH=3.57
CH3N	2.20
C=C-CH3	1.7
OCCH	2-2.7
C=CH	4.6-5.9
O-CH3	3.70
RCHO	9.3 - 9.9
H-C-C=O	2-2.7

	δ = 3.93(Eq H) δ = 3.37 (Axial H) 
CH'_3—C(=O)—O—CH''_2—CH'''_3	H’ = 1.9 H” = 3.7 H”’ = 0.9
[14]-annulene	Inner-4H δ = 0 Outer 10H γ = 7.6

^{13}C N M R FREQUENCY

Type of Carbon	**Chemical shift (δ) value(ppm)**
Unsaturated carbon atoms next to oxygen (C=O)	150-200
Unsaturated carbon atoms (C=C and aromatic)	10-150
Type of Carbon	Chemical shift (δ) value(ppm)
Saturated carbon atoms next to oxygen (CH3O, CH2O etc)	50-100
Saturated carbon	0-50

atoms (CH_3, CH_2, CH)	

IR FREQUENCY

Functional Group:Bond, Type	Characteristic absorption (cm^{-1})
Acid: C=O (stretch)	1700-1725 (strong)
Acid: O-H (stretch)	2500-3300 (strong, broad)
Alcohol: O-H (stretch, H-bonded)	3200-3600 (strong, broad)
Alcohol: O-H (stretch, free)	3500-3700 (strong, sharp)
Aldehyde: C=O (stretch)	1740-1720 (strong)
Amide: C=O (stretch)	1640-1690 (strong)
Amide N-H (stretch)	3100-3500

Amine: N-H (stretch)	3300-3500 (medium)
Anhydride: C=O (stretch)	1800-1830 and 1740-1775
Ester: C=O (stretch)	1735-1750 (strong)
Keto: C=O (stretch)	1670-1820 (strong)
Nitrile: CN (stretch)	2210-2260 (Medium)
Nitro: N-O (stretch)	1515-1560 and 1345-1385 (strong)

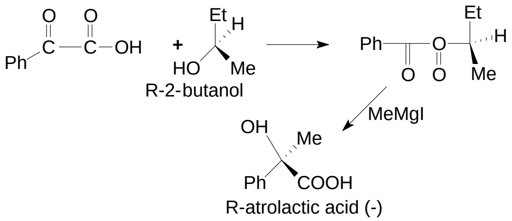
RESONANCE ENERGY

1. Benzene = 36 kcal/ mole
2. Napthalene = 61 kcal/ mole
3. Phenanthrene = 84 kcal/ mole
4. Pyridine = 28 kcal/mole
5. Furan = 16 kcal/mol
6. Thiophene = 29 kcal/mol
7. Pyrrole = 22 kcal/mol
8. Cyclopentadiene = 3 kcal/mol
9. Ethene = 0 kcal/mol

RULES AND DEFENATIONS

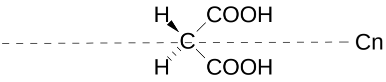
1. **Blanc’s rule :** If 1,4- and 1,5-dicarboxylic acid is heated with acetic anhydride, it gives cyclic anhydride, while 1,6- and 1,7-dicarboxylic acid gives cyclic ketones. So, by using Blanc’s rule, it is possible to determine the size of the rings.
2. **Saw-Tooth rule :** Some homologous series of organic compounds show an alternation or oscilation of melting point, *e.g.* in the fatty acid series the melting point of an “even” acid is higher than the “odd” acid immediately below and above it.
3. **Fries’ rule:** The most stable arrangement of a polynuclear compound is that form which has the maximum number of rings in the benzenoid condition, i.e., three double bonds in each individual ring.
4. **Hammond’s postulate:** If the reaction is strongly exothermic, then generally the transition state structure reassembles that of the reactants, i.e., existing bonds are almost intact and new bonds are very little formed. Similarly, transition state structure resembles that of the products when the reaction is strongly exothermic.
5. **Principle of microscopic reversibility:** The mechanism of any reaction, under a given set of conditions, is identical in microscopic detail to that of the reverse reaction under the same conditions, except that it proceeds in the opposite way.

6. **High Dilution principle of Ruggi :** By using sufficiently dilute solutions of hydroxyacids, the distance between different molecules can be made greater than the distance between the hydroxyl and carboxyl groups of same molecule, so that it can produce cyclic compound (lactone) instead of linear product.
7. **Prelog's rule :** It Correlates the configuration of chial alcohol with those of α -hydroxy acids. The rule predicts that R- alcohol produces (-) atrolactic acid (atrolactic acids is the outcome of results of asymmetric synthesis). It is used to detect the relative configuration (R or S) of an alcohol.

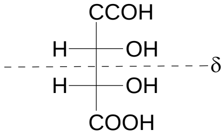


8. **Stereospecific reaction:** In a stereospecific reaction, starting materials differing only in their configuration are converted to stereoisomerically distinct products.
9. **stereoselective reation :** The preferential formation of one stereoisomer over another is called stereoselective reaction.

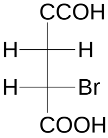
10. Homotopic ligand: Separate replacement of one or the other of such ligands by a new ligand gives identical products. Such ligands are interchangeable by Cn (n>1) operation. In the following compound, two hydrogen atoms are homotopic.



11. Enantiopic ligand: Separate replacement of one or the other of such ligands by a new ligand gives two different enantiomers. Such ligands are interchangeable by σ, I or Sn operation. In the following compound, two hydrogen atoms are enantiotopic.



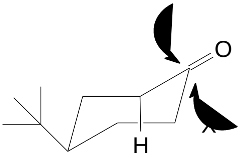
12. Diastereotopic ligands: Separate replacement of one or the other of such ligands by a new ligand gives diastereomers. Such ligands are not interchangeable by δ, I or Sn operation. In the following compound, two hydrogen atoms are diastereotopic.



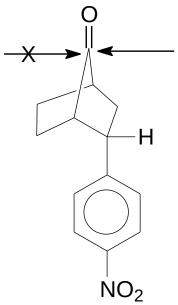
13. Cieplark effect: According to this model the nucleophile will attack from that face of the carbonyl or ethylene bond where the newly formed bond would be antiperiplanner to the most electron rich bond.

Electron-donating power:

$$\sigma_{C\text{-}O} < \sigma_{C\text{-}N} < \sigma_{C\text{-}C} < \sigma_{C\text{-}H} < \sigma_{C\text{-}S}$$



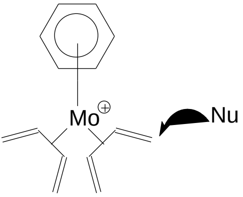
$(\sigma_{C\text{-}H} > \sigma_{C\text{-}C})$

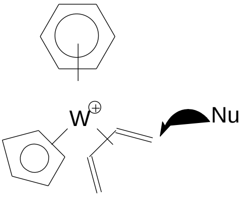


14. Devies-Green-Mingos rule (Attacking of nucleophile):

If a single organometallic complex has several polyene or polyenyl ligands, nucleophilic attach can take place at one side of ligand only with the following preference

- **a.** even before odd
- **b.** open before closed
- **c.** Even open : attack at terminal carbon
- **d.** Odd open: terminal only when M^+ is strongly electron withdrawing.

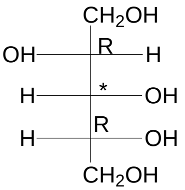




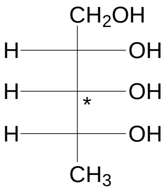
15.

- **a. Chirotopic atom :** The atom that resides in a chiral environment.
- **b. Streogenic Centre :** If transposition (exchange or permutation) of any two ligands causes the chirality of the centre reversed (giving a new stereoisomer) then that chiral centre is called streogenic.

Examples:

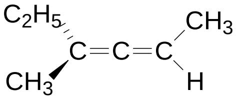


Here C(*) is chirotopic but non–stereogenic

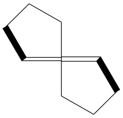


Here C(*) centre is chirotopic but sterreogenic.

16. Axial chiral molecule: chiral molecule which has no chiral atom, but chiral axis is present. Example :



17. Planner chiral molecule: chiral molecule containing no chiral point or axis but having chiral plane. Example: trans-cyclohexene, trans-cyclooctene.



18. No. of possible Stereoisomers (n = number of chiral centers):

a. Of type ABC

b. Of type ABBA like

CHO
|
A CHOH
|
B CHOH
|
C CHOH
|
CH_2OH

$2^n = 2^3 = 8$

CH_2OH
|
A CHOH
|
B CHOH
|
B CHOH
|
A CH_2OH
|
CH_2OH

For n = even

No. of optically active isomers = 2^{n-1}

No. of meso compound = $2^{(n/2)}-1$

For n = odd

No. of stereoisomers = 2^{n-1}

No. of meso isomers = $2^{(n-1)/2}$

Note: Those formulas may not work always work.

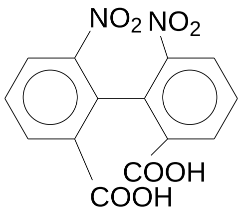
18. Turnover frequency : (For catalytic activity)

It indicates the no. of molecules of substrate transformed by one molecule of the catalyst per unit time.

19. Fluctional molecule : In these molecules the actual position of an atom fluctuates statistically between the extreme positions. This type of molecule can be studied by NMR.

20. Atropisomerism : In some crowded molecules, rotation about single bond may be sufficiently restricted to give a stable and isolable conformer known as atropisomers which are basically configurational isomer

Example



21. Bathochromic shift (a red shift): shift of spectral band position to longer wave length.

22. Hypsochromic shift: shift of spectral band position to shorter wave length.

23. Hyperchromic effect: Increase in absorption intensity.

24. Hypochromic effect: decrease in absorption intensity.

25. Index of hydrogen deficiency : (double bond equivallant) :

Index = Carbons – (Hydrogens/2) – (Halogens/2) + (Nitrogens/2) + 1

26. Baldwin's Rule for Ring Closure Reaction:

(i) All Exo-Tet reactions are favoured reactions

(ii) All Endo-Tet are disfavoured reactions

(iii) All Exo-Trig reactions are favoured reactions

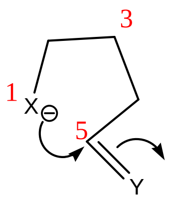
(iv) 3 to 5- Endo-Trig reactions are disfavoured reactions

(v) 6 to 7- Endo-Trig reactions are favoured reactions

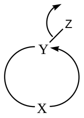
(vi) 3 to 7 – Endo-Dig reactions are favoured reactions

(vii) 3 to 4 – Exo-Dig reactions are disfavoured reactions

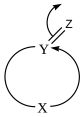
(viii) 5 to 7 – Exo-Dig are favoured one



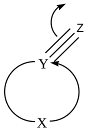
5-Exo-Trig



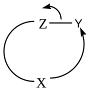
Exo-Tet (Exo-Tetrahedral)



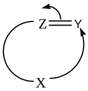
Exo-Trig (Exo-Trigonal)



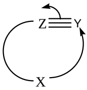
Exo-Dig (Exo-Digonal)



Endo-Tet (Exo-Tetrahedral)

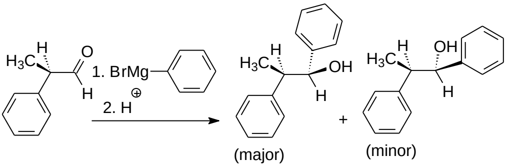


Endo-Trig (Endo-Trigonal)



Endo-Dig (Exo-Digonal)

27. Cram’s rule: Cram’s rule is used to qualitatively predict the diastereomeric ratio of the product formed in the addition of organometallic reagents to chiral ketones of the type R’COCHXR. According to this rule, one diastereomeric product will predominate which is formed by the approach of the entering group from the least hindered side in a conformation of the double bond flanked by the two least bulky groups attached to the adjacent asymmetric center.



SOME COMMENTS

1) **On Nucleophilicity :** When the nucleophilic site has the same atom, nucleophilicity paralles bascity

$MeO^- > PhO^- > MeCO_2^- > NO_3^-$.

When the attacking atoms are different but in the same periodic family, the one with the largest atomic weight is most reactive. Thereore : $I^- > Br^- > Cl^-$ (in water) due to less salvation but $Br^- > I^-$ in Me_2CO.

2) **On leaving group ability :** The best leaving group is the weakest base so, $C_6H_5SO_3^- > CH_3CO_2^- > C_2H_5O^-$

3) **On boiling point of alkene :** n-pentane has higher boiling point than neopentane. It is due to Vander-Waals forces. N-pentane has rod like structure while neopentane has sphere like. The more the v.w. forces between molecules the greater will be the v. w forces and hence higher will be the b. p.

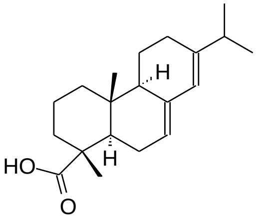
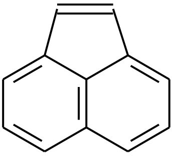
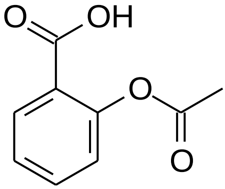
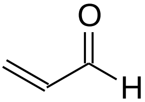
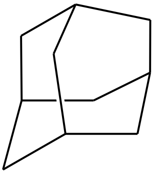
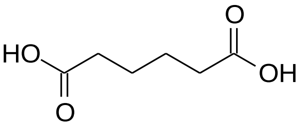
4) **On substitution Vs elimination:** In general 3^0 (Tertiary) halides tend to react by elimination, 1^0 (Primary) by substitution and 2^0 (Secondary) either by substitution or by elimination .

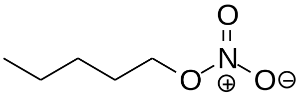
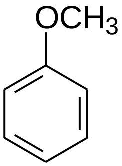
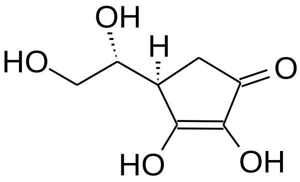
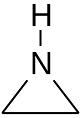
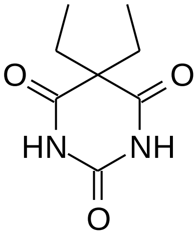
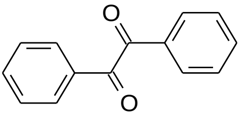
5) **On C-H bond length:** more 'S' character of a hybridized bond (eg. Sp > sp^3) less will be bond length.
6) **On acid strength of organic acid:** More stable the conjugate base is, stronger will be the acid.
7) **On oxidation of a ring:** More the electron density on ring, oxidation will be easier.
8) **On range of various spectra**

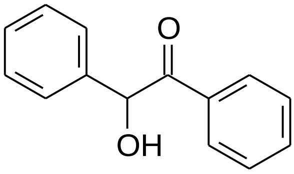
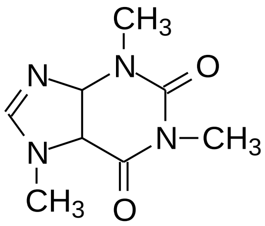
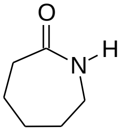
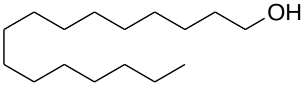
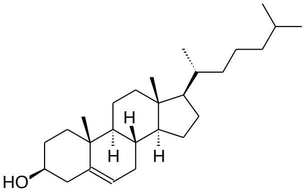
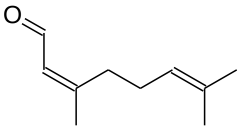
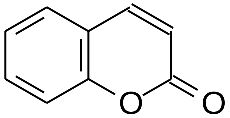
U. V.	Visible
λ (Wavelength) = < 400 n.m	λ = 400-800 n.m
KJ (Energy) = > 99.6 KJ	λ = (49.8 – 99.6) KJ
HZ (Frequency)= >0.75 x 10^{15} Hz	Hz = 0.375 x 10^{15} - 0.75 x 10^{15}
I. R.	
> 800 n.m	
< 49.8 KJ	
< 0.375 x 10^{15} Hz	

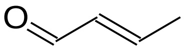
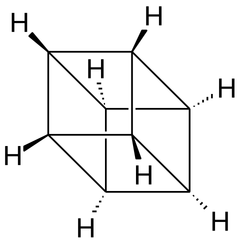
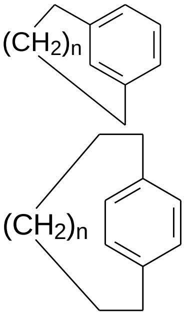
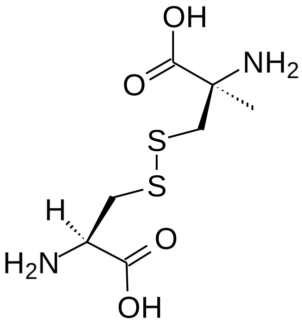
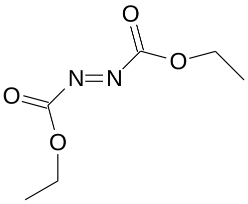
9) **Series of different spectra and wavelength (λ) :** Mohrsberg (γ ray) < U.V. < vissible < I.R < e.s.r. < NMR.

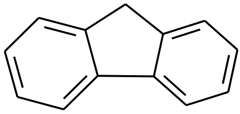
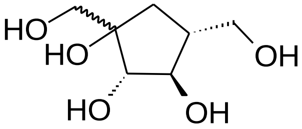
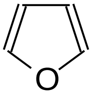
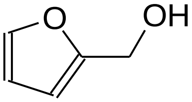
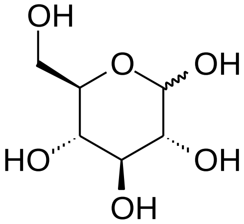
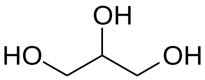
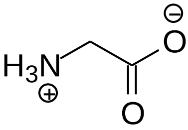
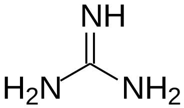
STRUCTURE OF COMPOUNDS

Abietic acid	
Acenaphthalene	
Aspirin (Acetylsalicylic acid)	
Acrolein	
Adamantane	
Adipic acid	
Amyl nitrate	

	
Anisole	
Ascorbic acid (Vitamin C)	
Aziridine	
Barbital	
Benzil	
Benzoin	

	
Caffeine	
Caprolactam	
Cetyl alcohol	
Cholesterol	
Citral or limonal	
Coumarin	
Crotonaldehyde	

	
Cubane	
Cyclophanes	
Cystine	
Diethylazodicarboxylate (DEAD)	
Fluorene	

	
Fructose	
Furan	
Furfuryl alcohol	
Glucose	
Glycerol	
Glycine	
Guanidine	
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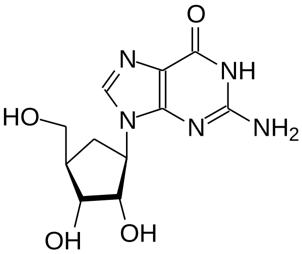
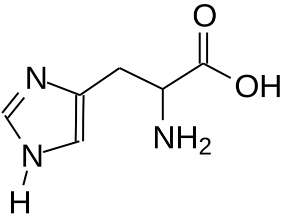
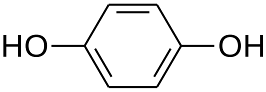
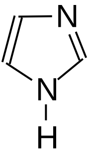
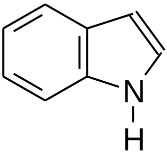
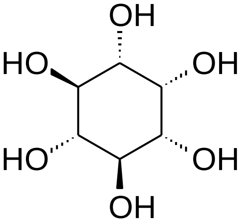
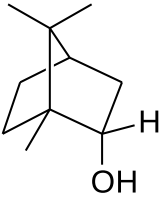
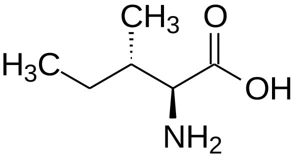
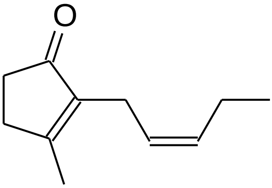
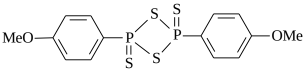
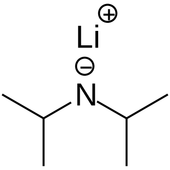
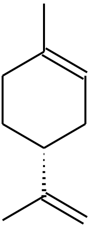
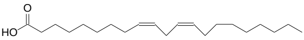
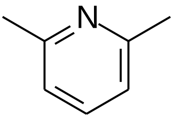
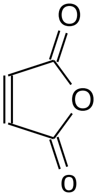
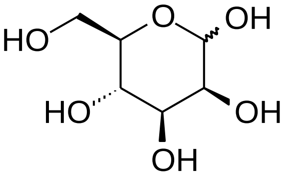
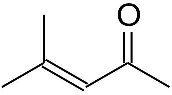
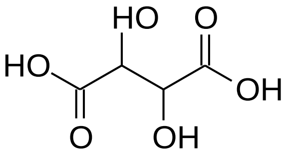
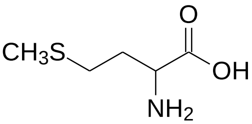
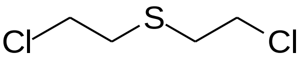
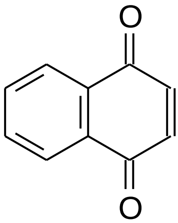
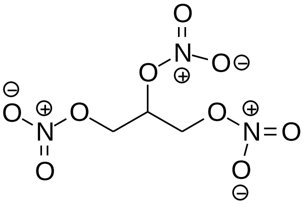
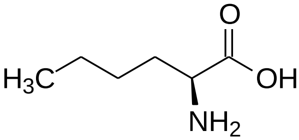
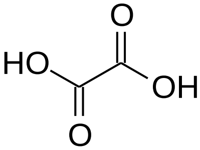
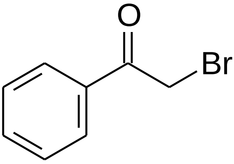
	
Histidine	
Hydroquinone	
Imidazole	
Indole	
Inositol	

Borneol	
Isoleucine	
Jasmone	
Lawesson’s reagent	
Lithium diisopropylamide (LDA)	
Limonene	
Linoleic acid	

2,6-Lutidine	
Maleic anhydride	
Mannose	
Mesityl oxide	
Tartaric acid	
Methionine	
Mustard gas	

Naphthoquinone	
Nitroglycerin	
Norleucine	
Oxalic acid	
Phenacyl bromide	
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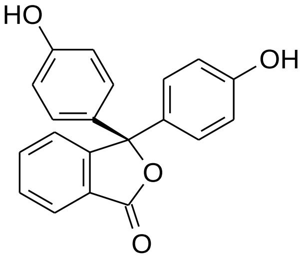
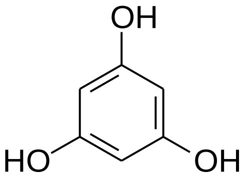
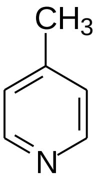
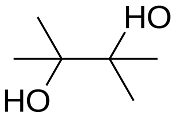
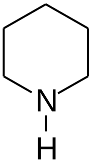
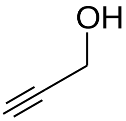
	
Phloroglucinol	
4-Picoline	
Pinacol	
Piperidine	
Propargyl alcohol	
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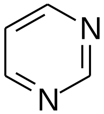
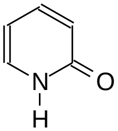
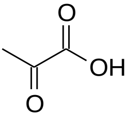
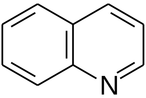
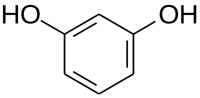
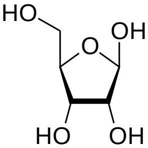
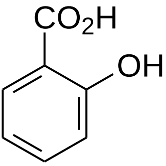
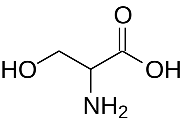
	
2-Pyridone	
Pyruvic acid	
Quinoline	
Resorcinol	
Ribose	
Salicylic acid	
Serine	
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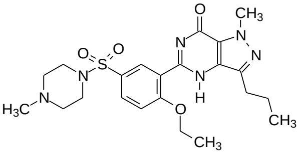
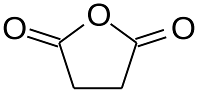
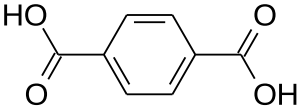
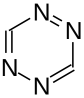
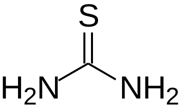
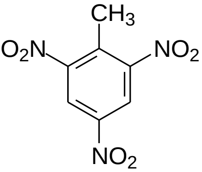
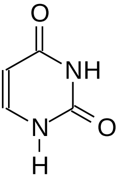
	
Succinic anhydride	
Terephthalic acid	
Tetrazine	
Thiourea	
Trinitrotoluene (TNT)	
Uracil	
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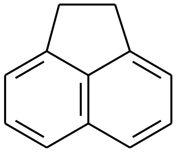
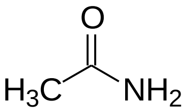
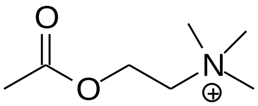
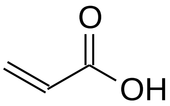
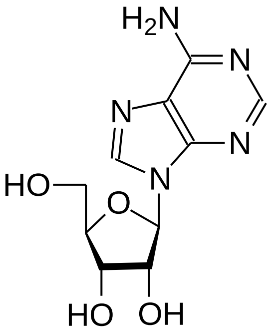
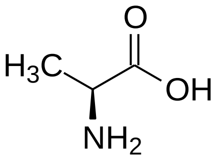
	
Acetamide	
Acetylcholine	
Acrylic acid	
Adenosine	
Alanine	
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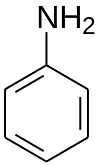
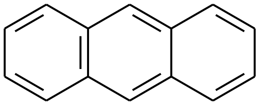
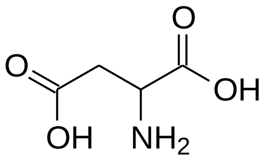
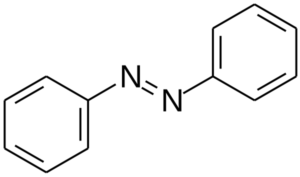
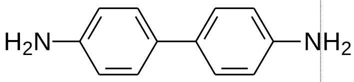
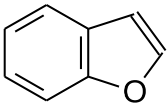
	
Anthracene	
Aspartic acid	
Azobenzene	
Benzidine	
Benzofuran	
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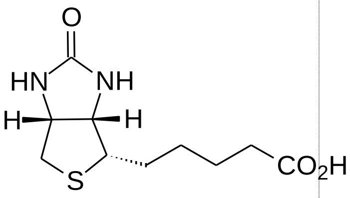
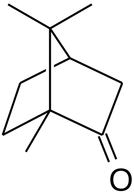
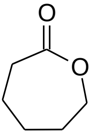
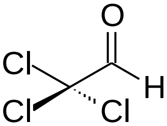
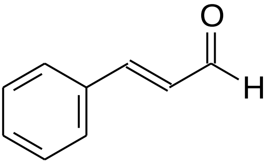
	
Camphor	
Caprolactone	
Chloral	
Cinnamaldehyde	
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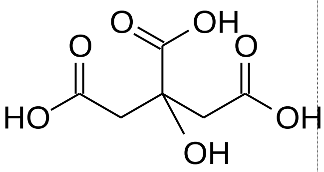
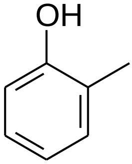
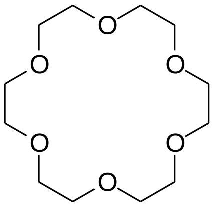
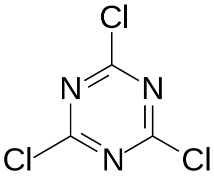
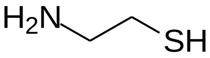
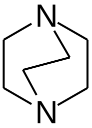
	
o-Cresol	
18-Crown-6	
Cyanuric chloride	
Cysteamine	
DABCO (1,4-diazabicyclo[2.2.2]octane)	
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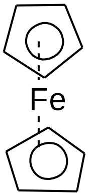
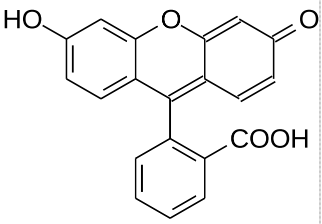
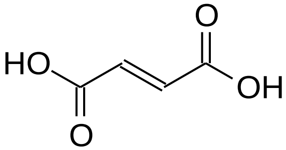
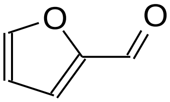
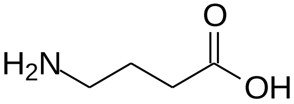
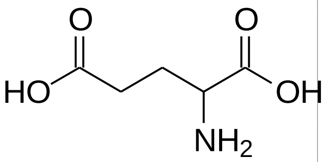
	
Fluorescein	
Fumaric acid	
Furfural	
gamma-Aminobutyric acid	
Glutamic acid	
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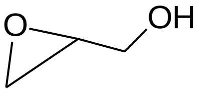
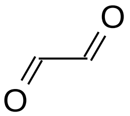
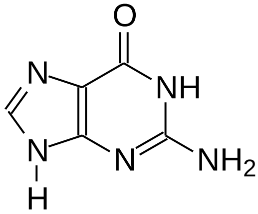
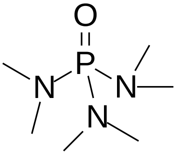
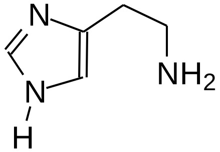
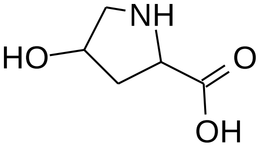
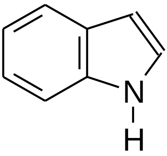
	
Glyoxal	
Guanine	
Hexamethylphosphoramide (HMPA)	
Histamine	
Hydroxyproline	
Indene	
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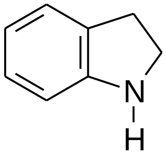
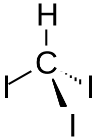
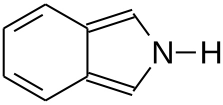
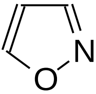
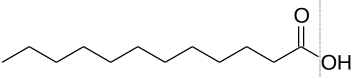
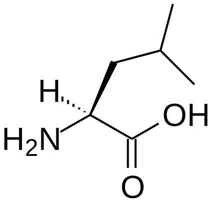
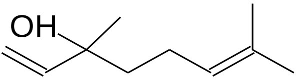
	
Iodoform	
Isoindole	
Isoxazole	
Lauric acid	
Leucine	
Linalool	
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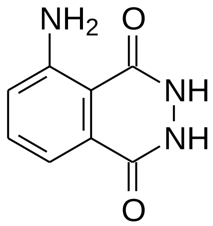
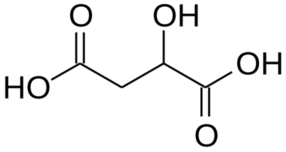
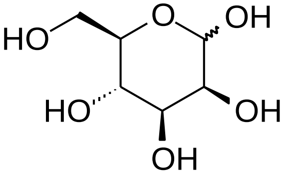
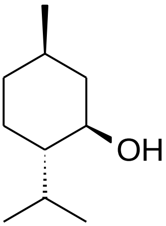
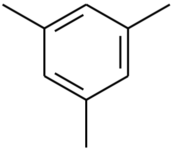
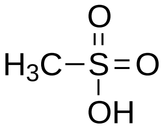
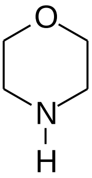
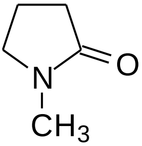
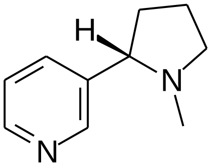
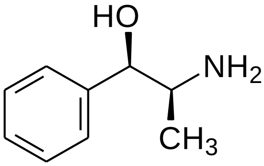
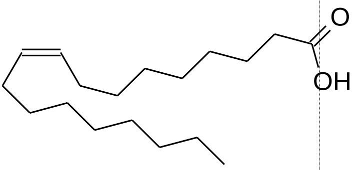
	
Malic acid	
Mannose	
Menthol	
Mesitylene	
Methanesulfonic acid	

Morpholine	
N-Methyl-2-pyrrolidone (NMP)	
Nicotine	
Norephedrine	
Oleic acid	
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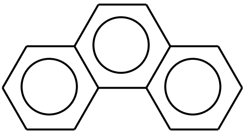
Phenanthrene	
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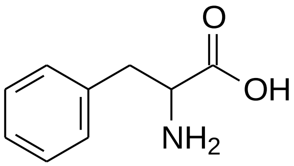
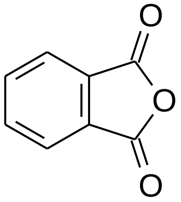
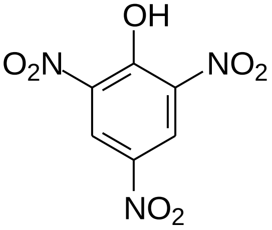
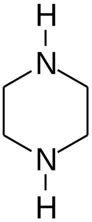
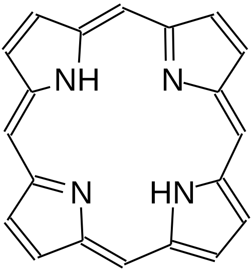
	
Phthalic anhydride	
Picric acid	
Piperazine	
Porphyrin	
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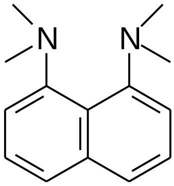
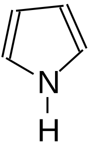
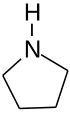
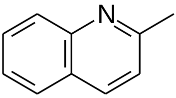
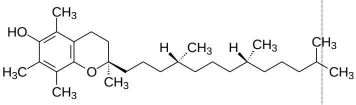
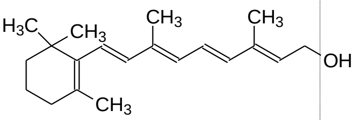
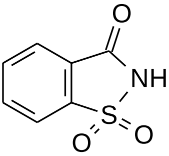
	
Pyrrole	
Pyrrolidine	
Quinaldine	
Alpha-tocopherol	
Retinol	
Sacharin	
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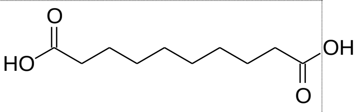
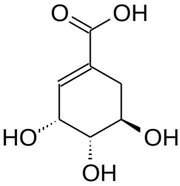
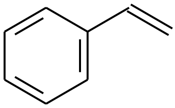
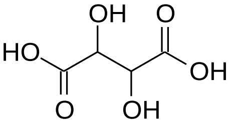
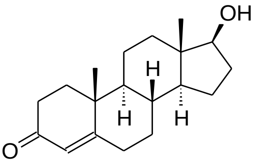
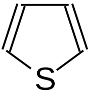
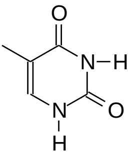
	
Shikimic acid	
Styrene	
Tartaric acid	
Testosteron	
Thiophene	
Thymine	
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	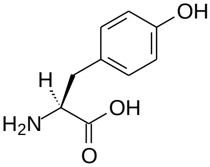
Vanillin