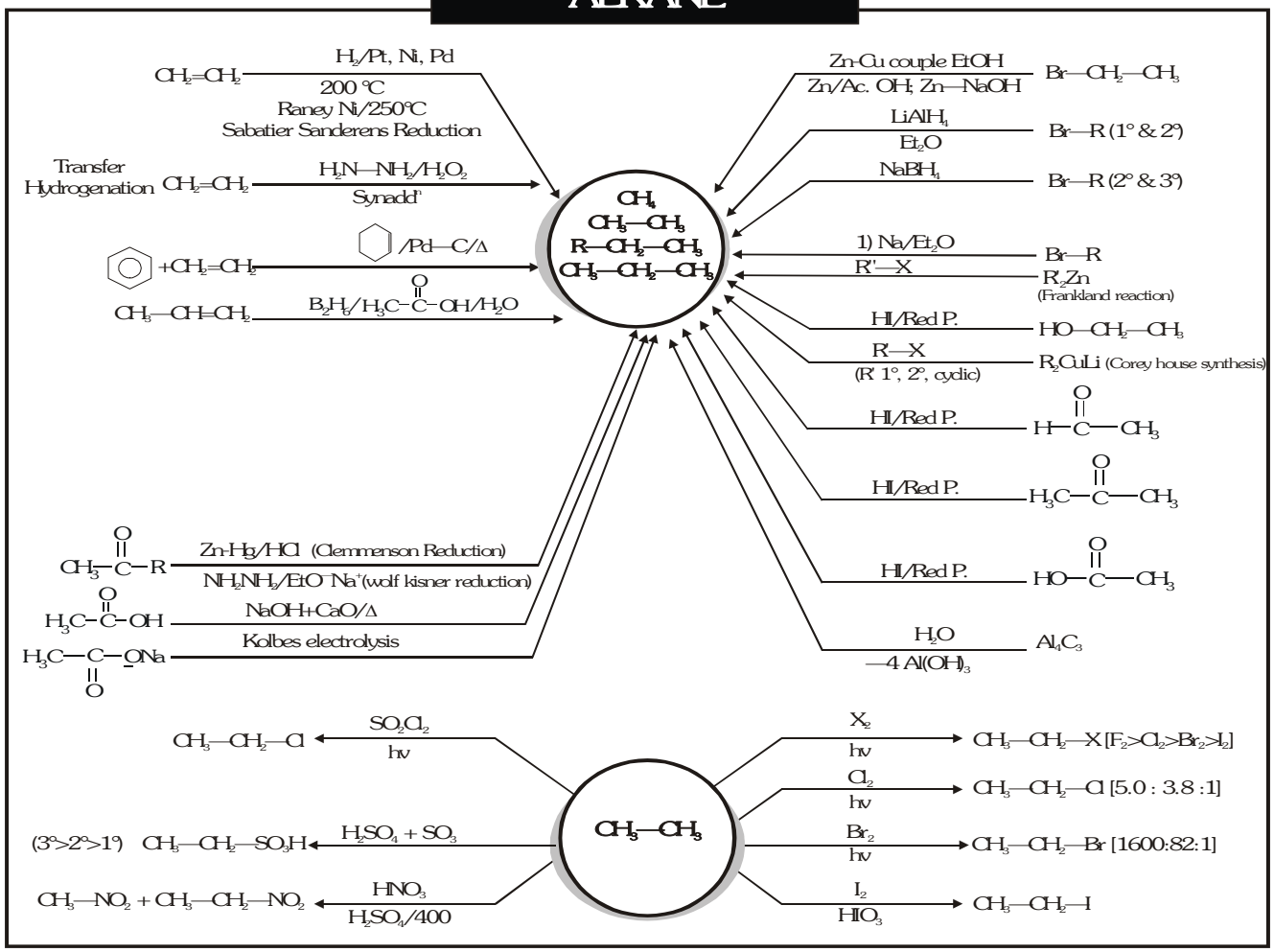
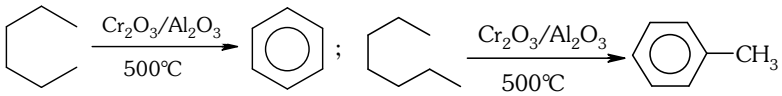
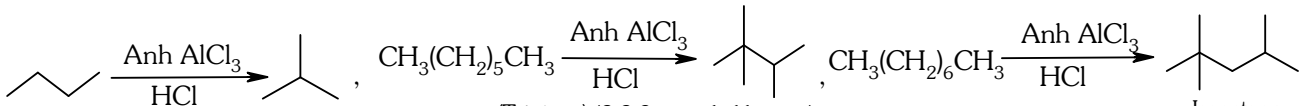
ALKANE



Aromatization :



Isomerization :



Combustion :

$$C_nH_{2n+2} + \frac{3n+1}{2}O_2 \xrightarrow{\Delta} nCO_2 + (n+1)H_2O$$

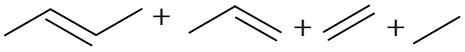
$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

$$CH_3 — CH_3 + \frac{7}{2}O_2 \rightarrow 2CO_2 + 3H_2O$$

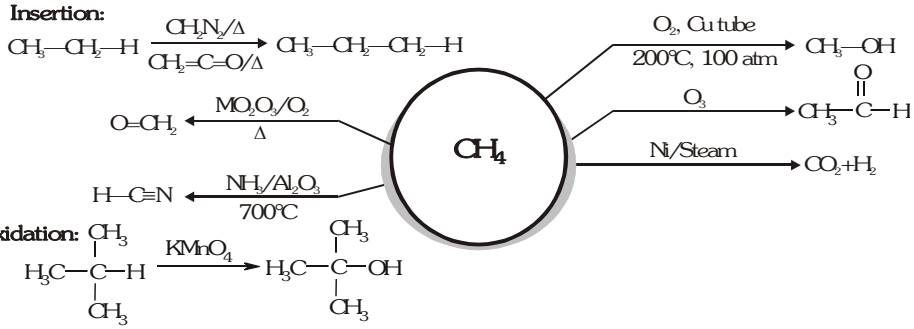
Pyrolysis:

$$2CH_3 — CH_2 — CH_3 \xrightarrow[600°C]{\Delta} CH_3 — CH = CH_2 + CH_3 — CH_3 + CH_4 + H_2$$

$$CH_3 — CH_2 — CH_2 — CH_3 \xrightarrow[600°C]{\Delta} CH_3 — CH_2 — CH = CH_2$$

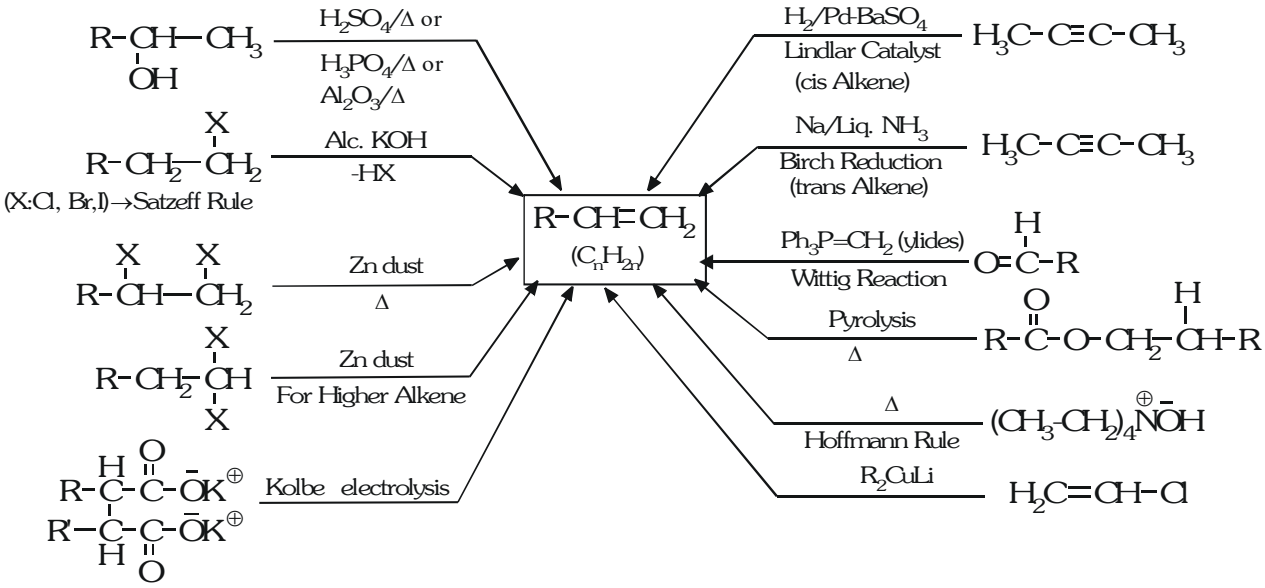


Insertion:



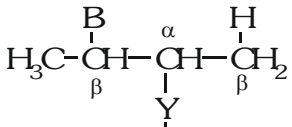
oxidation:

Nutshell Preparation of ALKENE



Elimination Reaction

E^1, E^2 & E^1CB



$H_3C\text{-}CH=CH\text{-}CH_3$

more substituted alkene is major product

↓

Satzeff Rule

Ⓨ I,Br, Cl, OTs, OBS

in presence of base

$\bar{O}H$ / MeO^- / EtO^-

(Alc. KOH)

6:1 (trans to cis)

Y : OH/Conc. H_2SO_4/Δ

: OH/H_3PO_4/Δ

: OH/Al_2O_3/Δ

: OH/P_2O_5 or $ZnCl_2/\Delta$

$H_3C\text{-}CH_2\text{-}CH=CH_2$

Least substituted alkene is major product

↓

Hoffman Rule

: In presence of bulky base

: When more bulky groups are present around B(C)

: When y; is $\overset{+}{N}Me_3/OH/\Delta$

: $\overset{+}{S}R_2/B/\Delta$

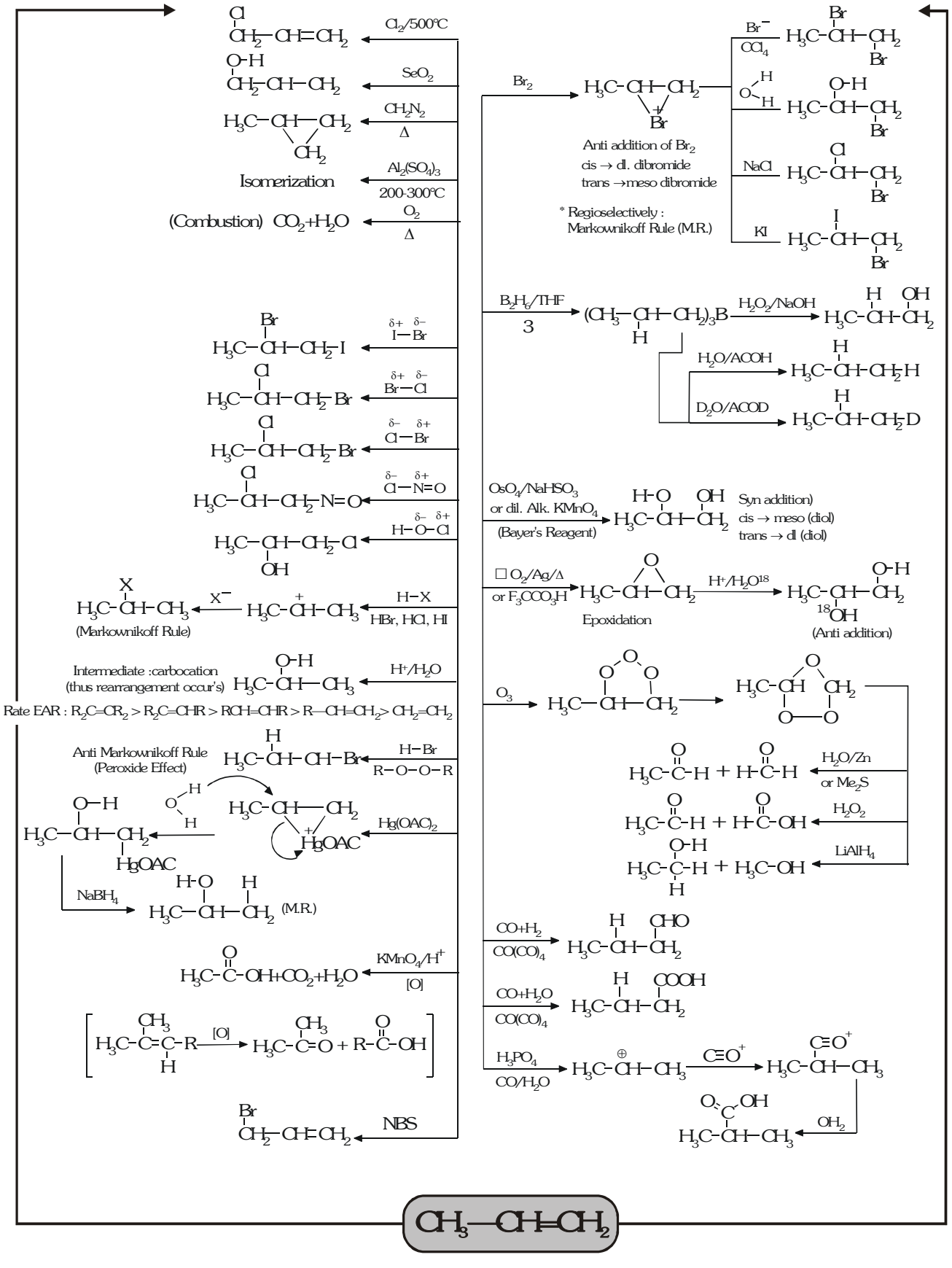
: $\overset{+}{N}R_2/\Delta$ (with O^-)

: F / Base

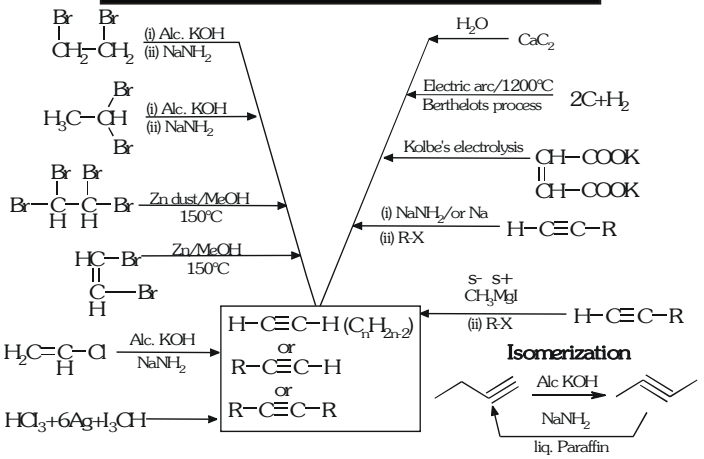
: Pyrolysis of ester

Y : OH/ThO_2/Δ

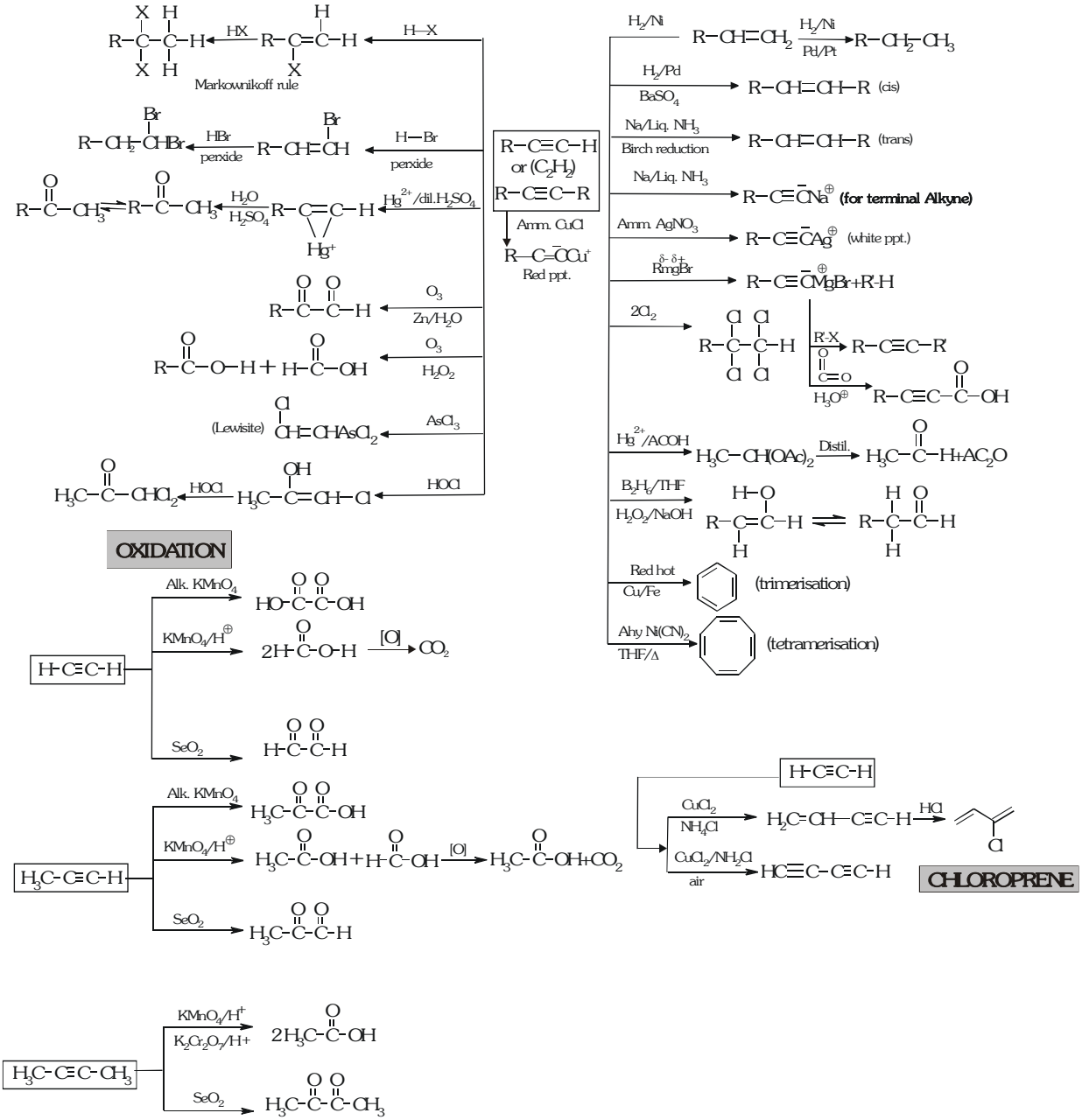
Nutshell reaction of Alkene



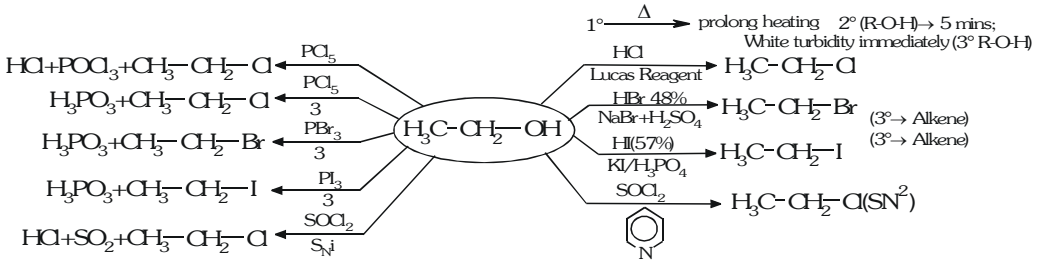
Nutshell Preparation of Alkyne

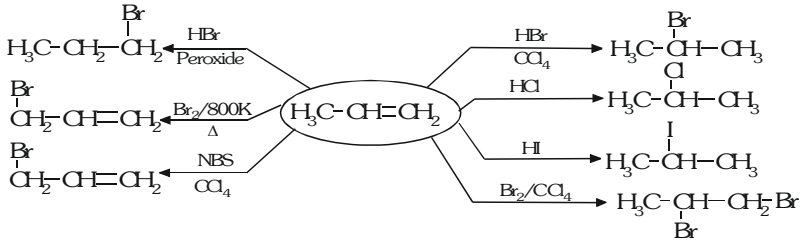


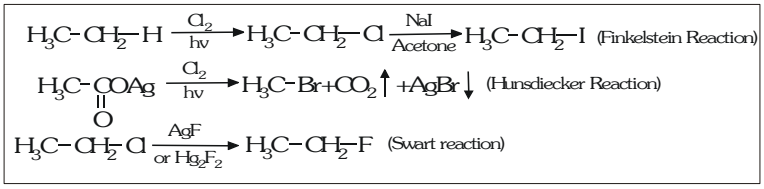
Nutshell reaction of Alkyne

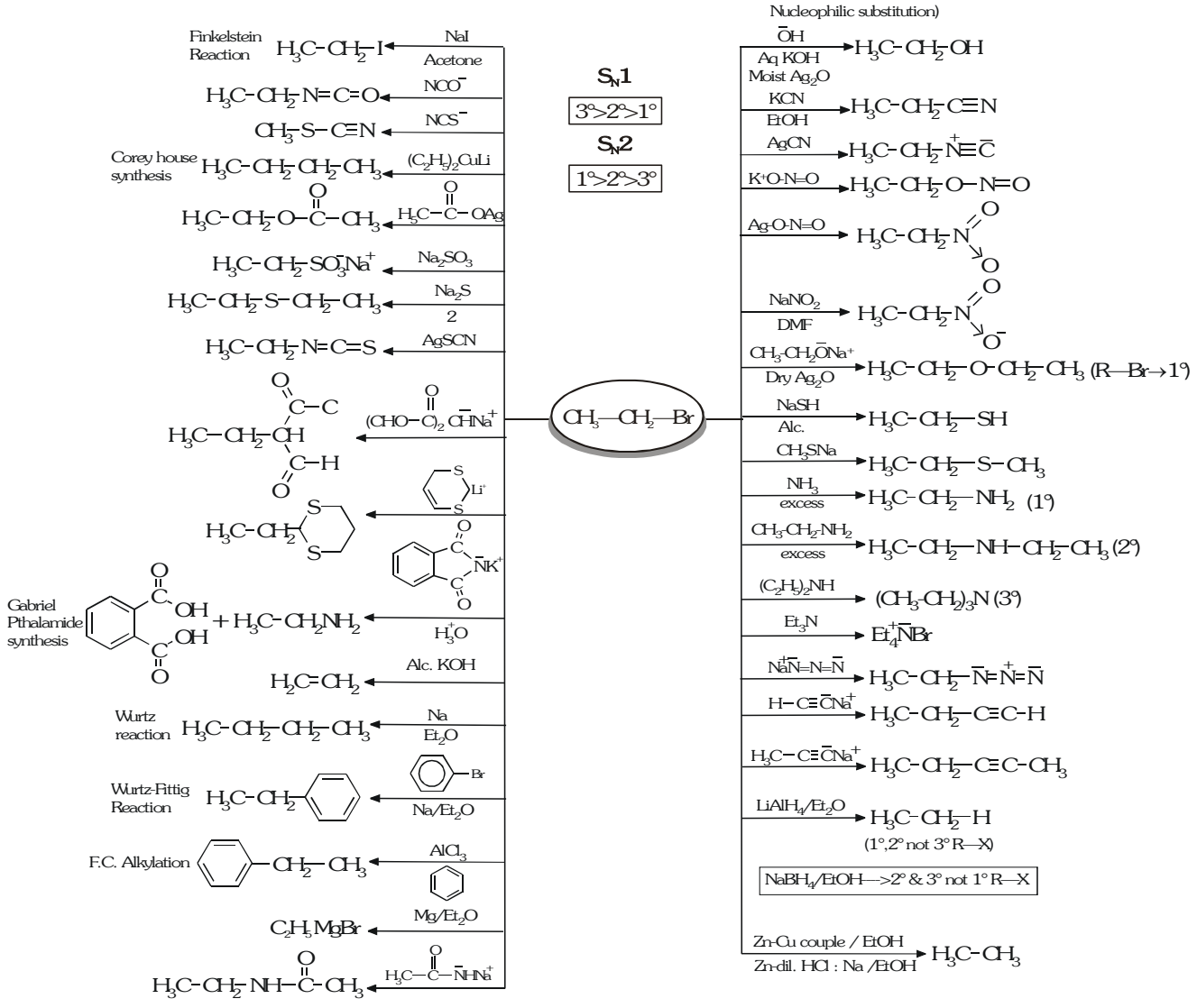


Nutshell Preparation of ALKYL HALIDE

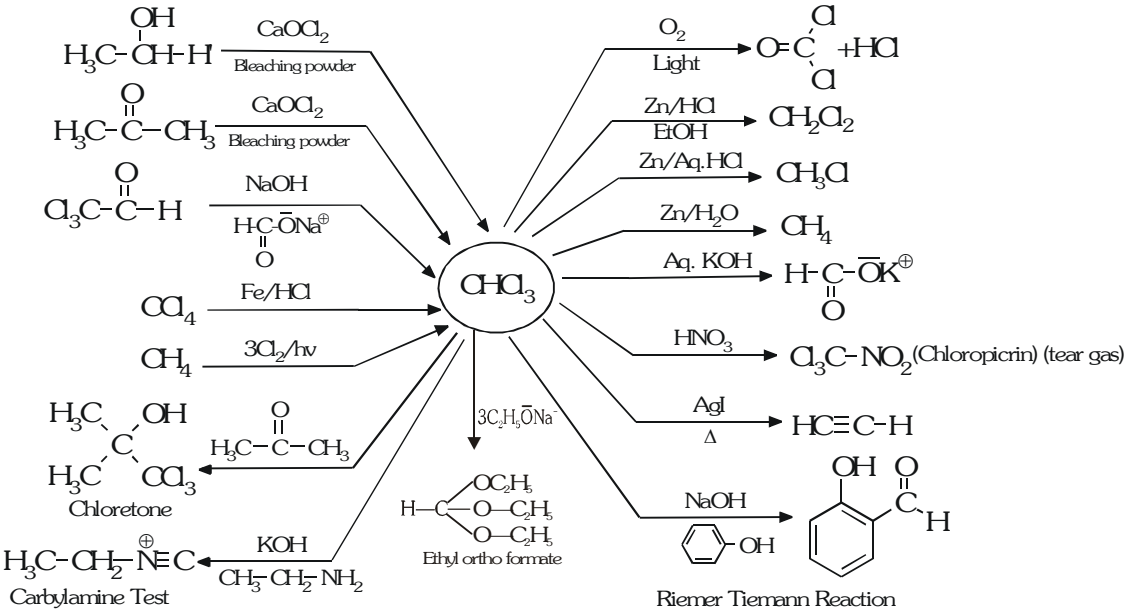


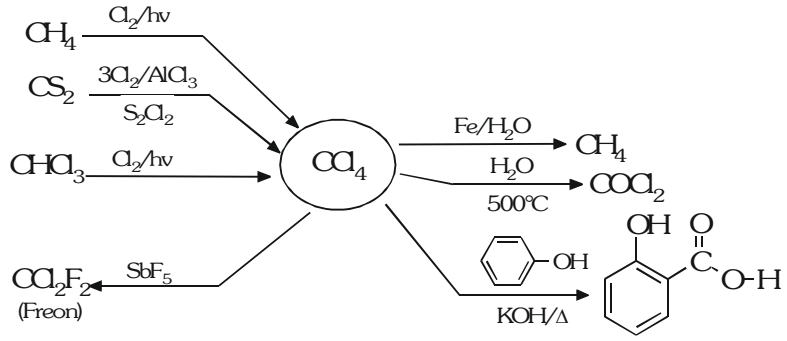


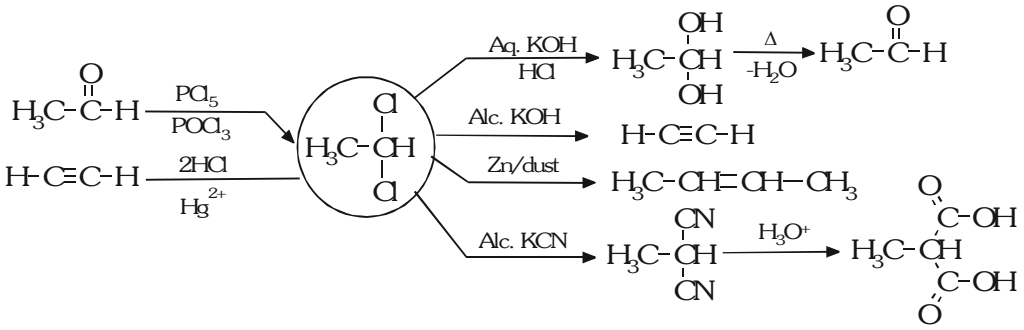


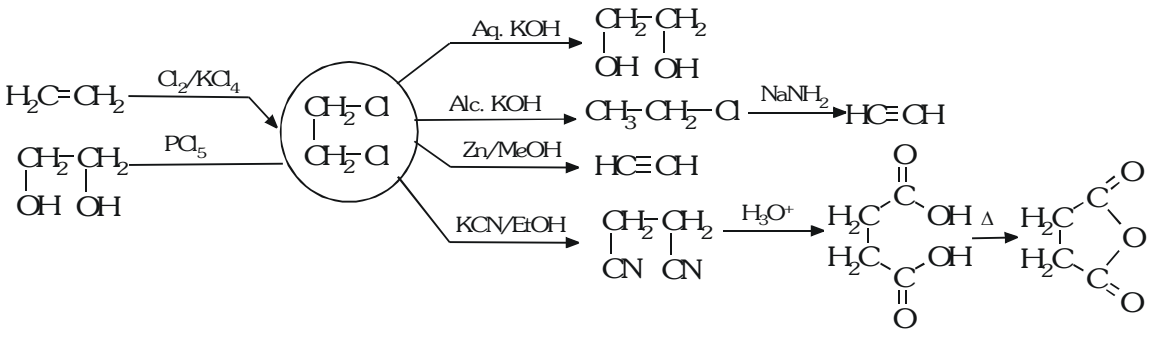


Nutshell Preparation & Properties of DI, TRI and Tetra Halides









Comparison of S_N1 and S_N2

		S_N1	S_N2
A	Kinetics	1st order	2nd order
B	Rate	k[RX]	k[RX][Nu:⁻]
C	Stereochemistry	Racemisation	Inversion
D	Substrate	3° > 2°>1° > MeX	MeX > 1° > 2°>3°
E	Nucleophile	Not important	Needs Strong Nu
F	Solvent	Good ionizing	Faster in aprotic
G	Leaving Group	Needs Good LG	Needs Good LG
H	Rearrangement	Possible	Not Possible

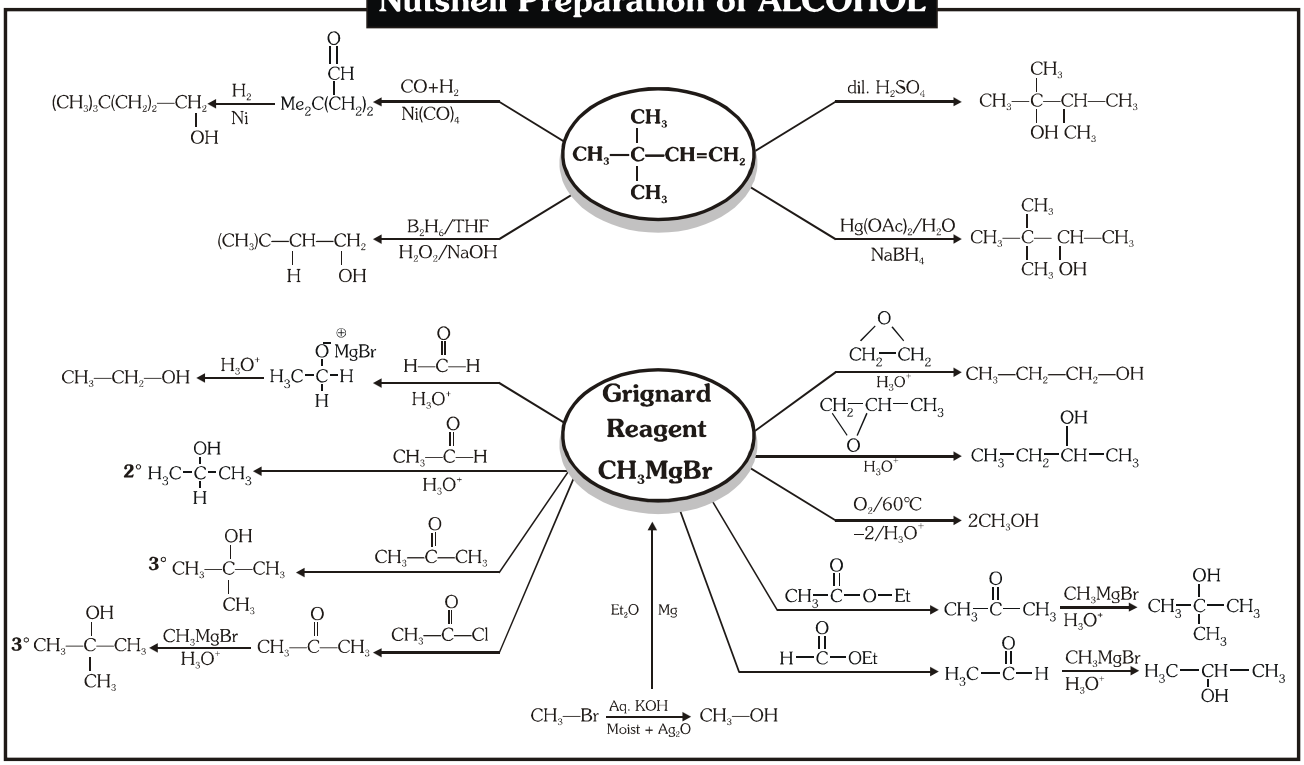
Comparision of E1 and E2

		E1	E2
A	Kinetics	1st order	2nd order
B	Rate	k[RX]	k[RX][B:⁻]
C	Stereochemistry	No special geometry	Anti-periplanar
D	Substrate	3° > 2°>>>1°	3° >2° >1°
E	Base Strength	Not important	Needs Strong bases
F	Solvent	Good ionizing	Polarity not import
G	Leaving Group	Needs Good LG	Needs Good LG
H	Rearrangement	Possible	Not Possible

Summary of S_N1, S_N2, E1, and E2 reactions

RX	Mechanism	Nu:⁻/:B⁻	Solvent	Temp.
1°	S_N2	Better Nu:⁻ $HO:^-$, $C_2H_5O:^-$	Polar aprotic	Low
	E2	Strong & bulky base $(CH_3)_3CO:^-$		High
2°	S_N2	$HO:^-C_2H_5O:^-$	Polar aprotic	Low
	E2	$(CH_3)_3CO:^-$		High
	(S_N1)	(Solvent	Polar aprotic	(Low)
	(E1)	(Solvent)		(High)
3°	S_N1	Solvent	Protic	Low
	E1	Solvent	Protic	High

Nutshell Preparation of ALCOHOL



☐ Reduction

$$H_3C-\overset{O}{\overset{\|}{C}}-H \xrightarrow[NaBH_4\,/\,EtOH]{LiAlH_4\,/\,H_2O} CH_3-CH_2-OH$$

$$H_3C-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow[NaBH_4\,/\,EtOH]{LiAlH_4\,/\,H_2O} H_3C-\underset{OH}{\underset{|}{CH}}-CH_3$$

$$H_3C-\overset{O}{\overset{\|}{C}}-Cl \xrightarrow{LiAlH_4\,/\,Et_2O} CH_3-CH_2-OH$$

$$H_3C-CH_2-\overset{O}{\overset{\|}{C}}-O-C_2H_5 \xrightarrow[Na\,/\,EtOH]{LiAlH_4\,/\,Et_2O} H_3C-CH_2-\underset{OH}{\underset{|}{CH_2}} + C_2H_5OH$$

$$H_2C\overset{O}{\diagup\!\diagdown}CH_2 \xrightarrow[H_3O^+]{LiAlH_4\,/\,Et_2O} CH_3-CH_2-OH$$

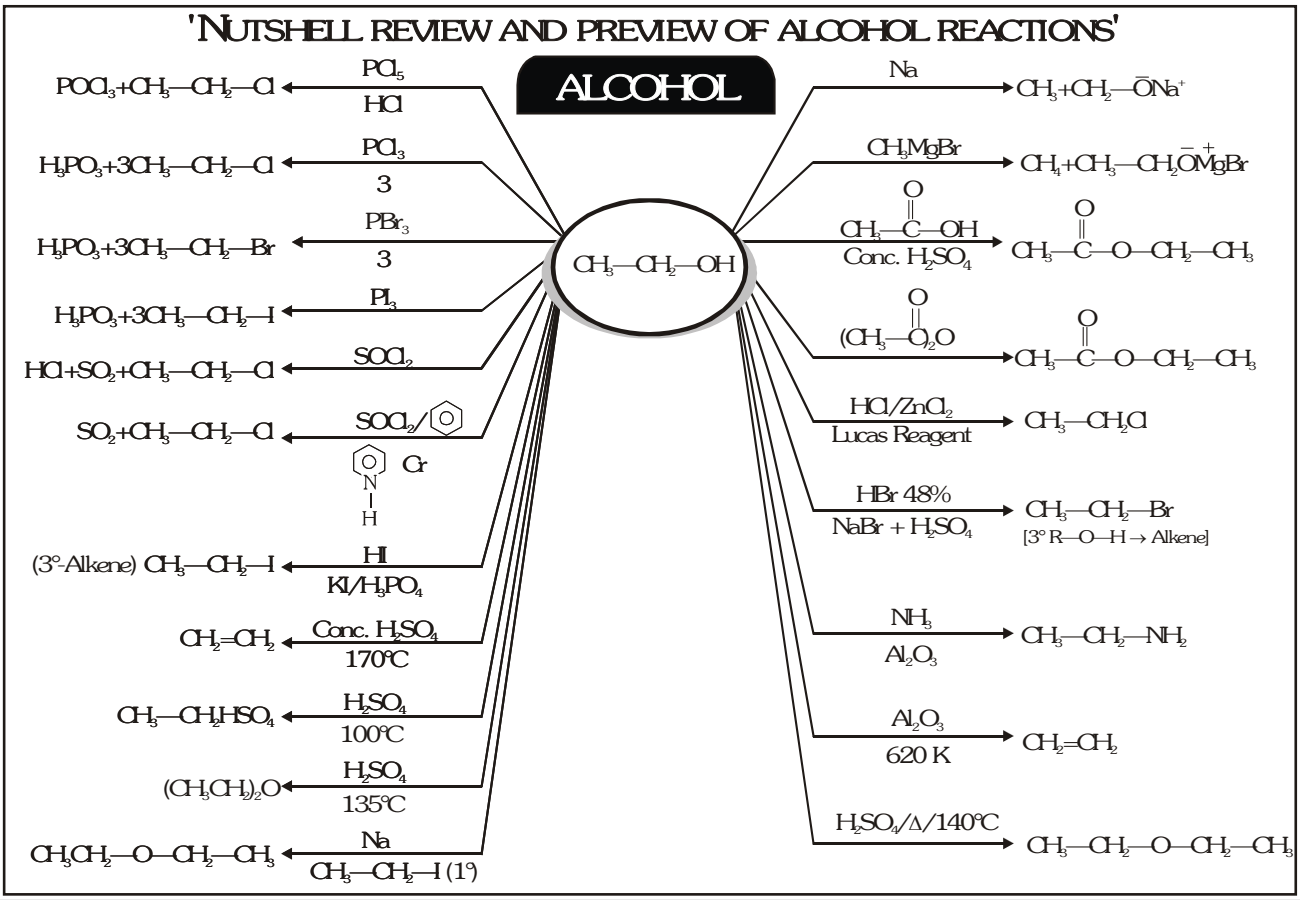
$$H_3C-CH\overset{O}{\diagup\!\diagdown}CH_2 \xrightarrow[H_3O^+]{LiAlH_4\,/\,Et_2O} H_3C-\underset{OH}{\underset{|}{CH}}-CH_2-H$$

☐ By Fermentation

$$\underset{\text{sucrose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{\text{Invertase}} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6} \xrightarrow{\text{Zymase}} 2C_2H_5OH + CO_2$$

zymase ↑

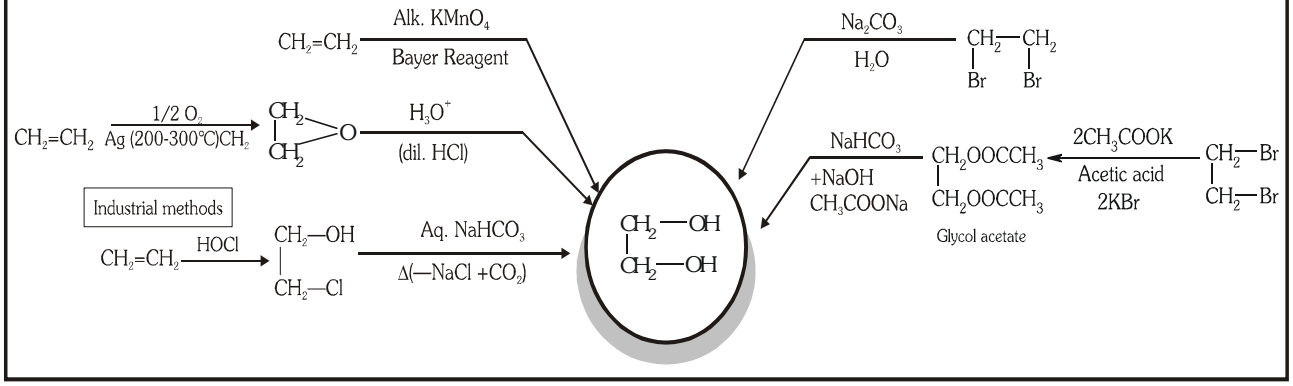
$$2\underset{\text{starch}}{(C_6H_{10}O_5)_n} + nH_2O \xrightarrow{\text{Diastase}} nC_{12}H_{22}O_{11} \xrightarrow[H_2O]{\text{Maltose}} 2C_6H_{12}O_6$$



Reagent	$H_3C-CH_2-CH_2-CH_2-OH$ 1° Alcohol	$H_3C-CH_2-CH(^{18}OH)-CH_3$ 2° Alcohol	$H_3C-C(CH_3)_2-OH$ 3° Alcohol
PCC/CH_2Cl_2 PDC/CH_2Cl_2 Jones Reagent H_2CrO_4/Aq. Acetone	$H_3C-CH_2-CH_2-C(=O)-H$	$H_3C-CH_2-C(=O)-CH_3$	No reaction
$K_2Cr_2O_7/H^{\oplus}$ $KMnO_4/H^+/\bar{O}H/\Delta$	$H_3C-CH_2-CH_2-C(=O)-H$	$H_3C-C(=O)-OH + CH_3-C(=O)-OH$	
Cu/500°C	$H_3C-CH_2-CH_2-C(=O)-H$	$CH_3-CH_2-C(=O)-CH_3$	$H_3C-C(CH_3)=CH_2$
$\xrightarrow[\text{Acetone or cyclohexanone}]{Al(OBu^t)_3}$	$H_3C-CH_2-CH_2-C(=O)-H$	$H_3C-CH_2-C(=O)-CH_3$	-
Lucas Reagent $HCl/ZnCl_2$	Cloudiness appear upon heating after 30 mins. at normal temp. no. reaction	within five min.	Immediately
Victor Mayer's Test			
P/I_2	$CH_3-CH_2-CH_2-CH_2-I$	$H_3C-CH_2-CH(CH_3)-I$	$H_3C-C(CH_3)_2-I$
$AgNO_2$	$CH_3-CH_2-CH_2-NO_2$	$H_3C-CH_2-CH(CH_3)-NO_2$	$(CH_3)_3-NO_2$
HNO_2 NaOH	$H_3C-CH_2-C(=N-OH)-NO_2$ Nitrolic acid	$H_3C-CH_2-CH(N=O)-NO_2$	No reaction ↓

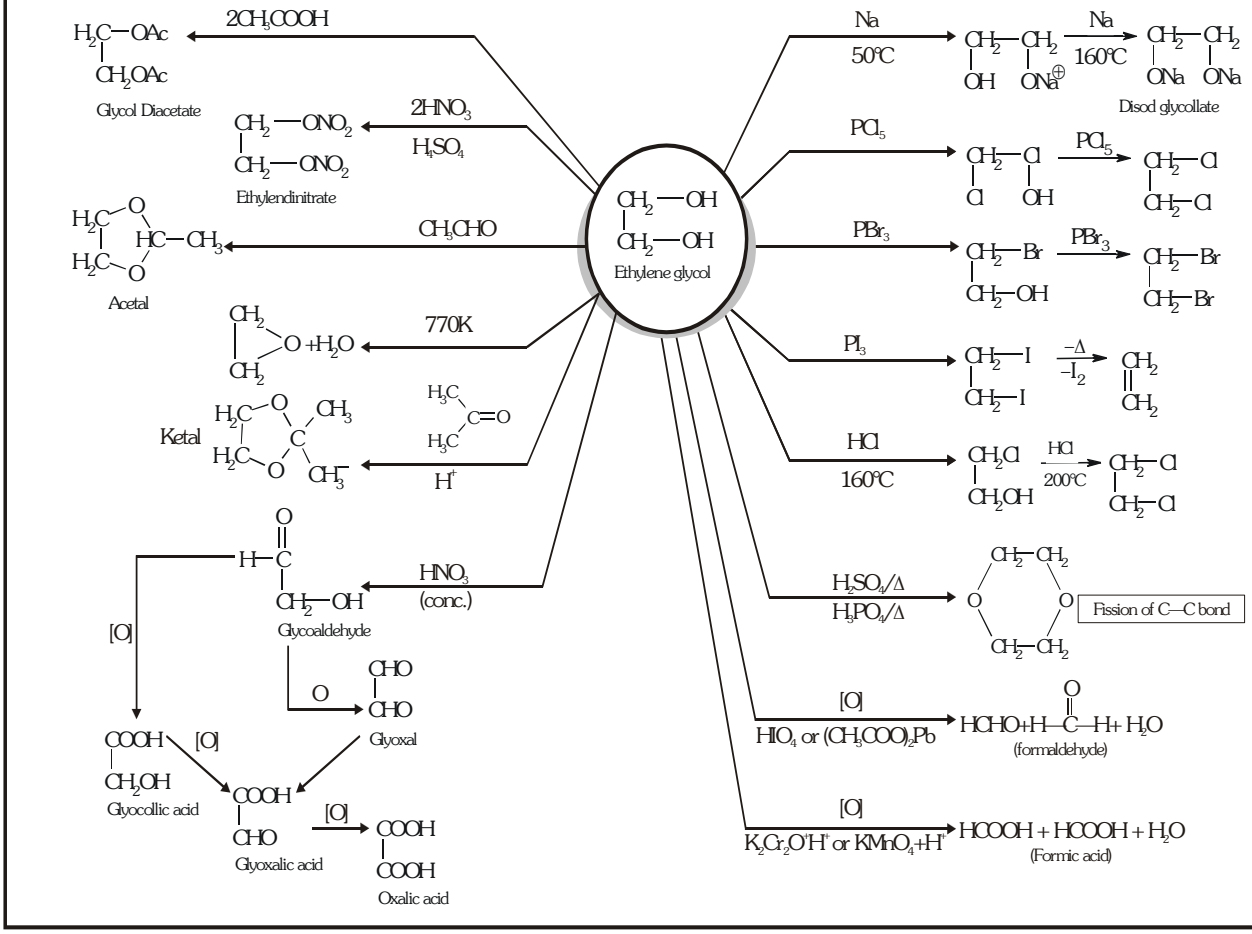
Dihydric Alcohol

Methods of Preparation (Antifreeze Agent)

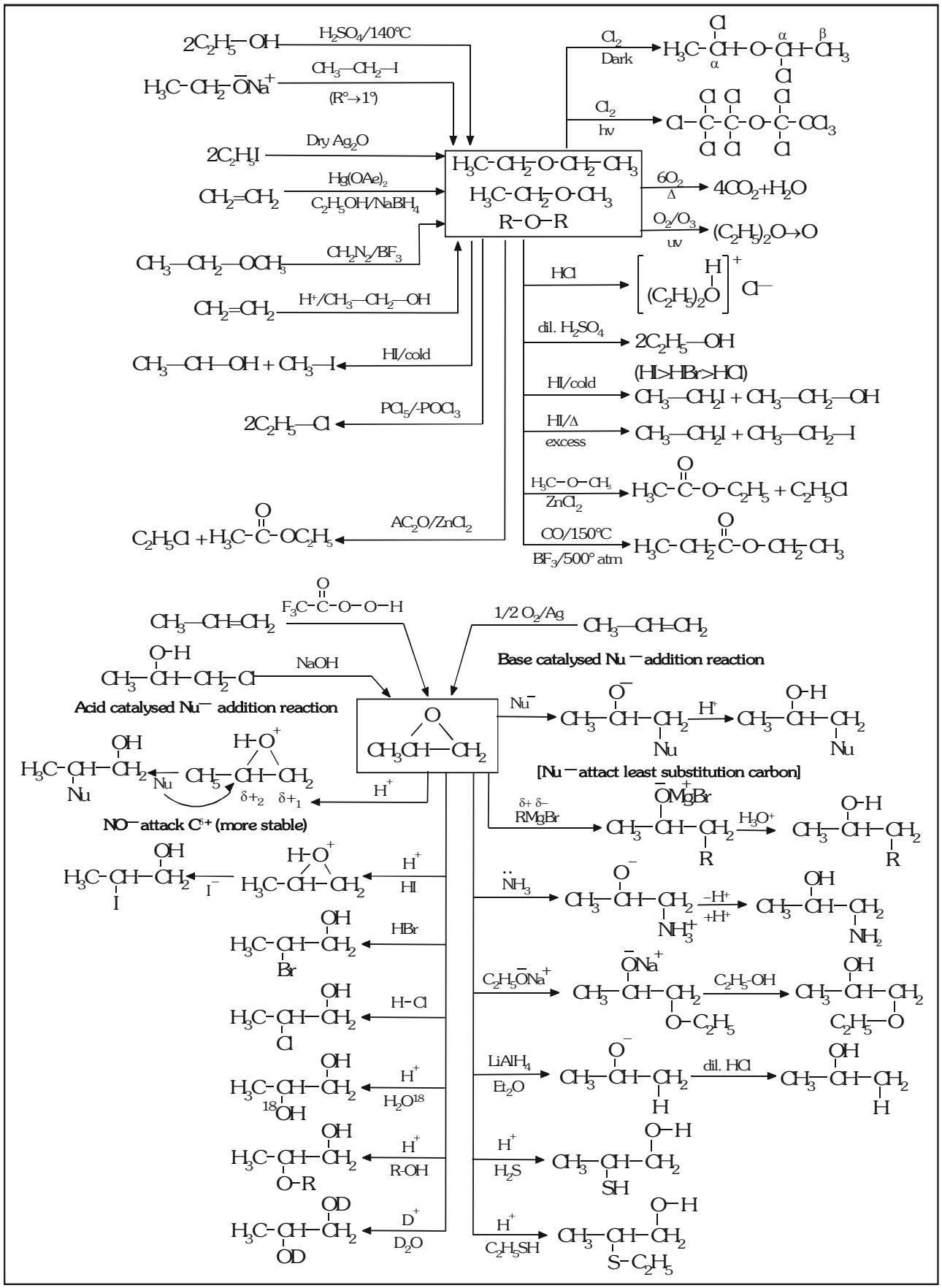


Chemical Properties

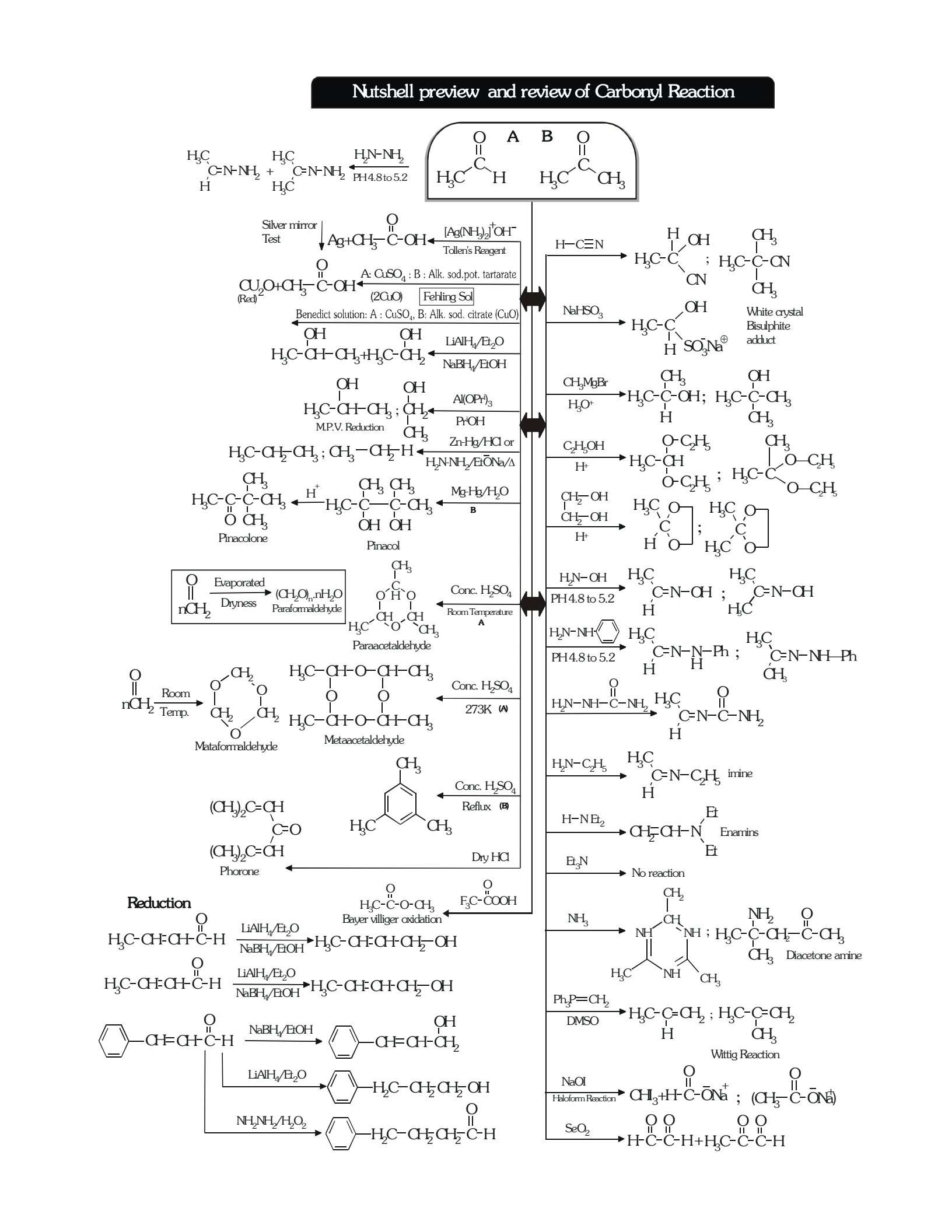
Two 1_0 Alcoholic group : one OH group always react completely before other group react

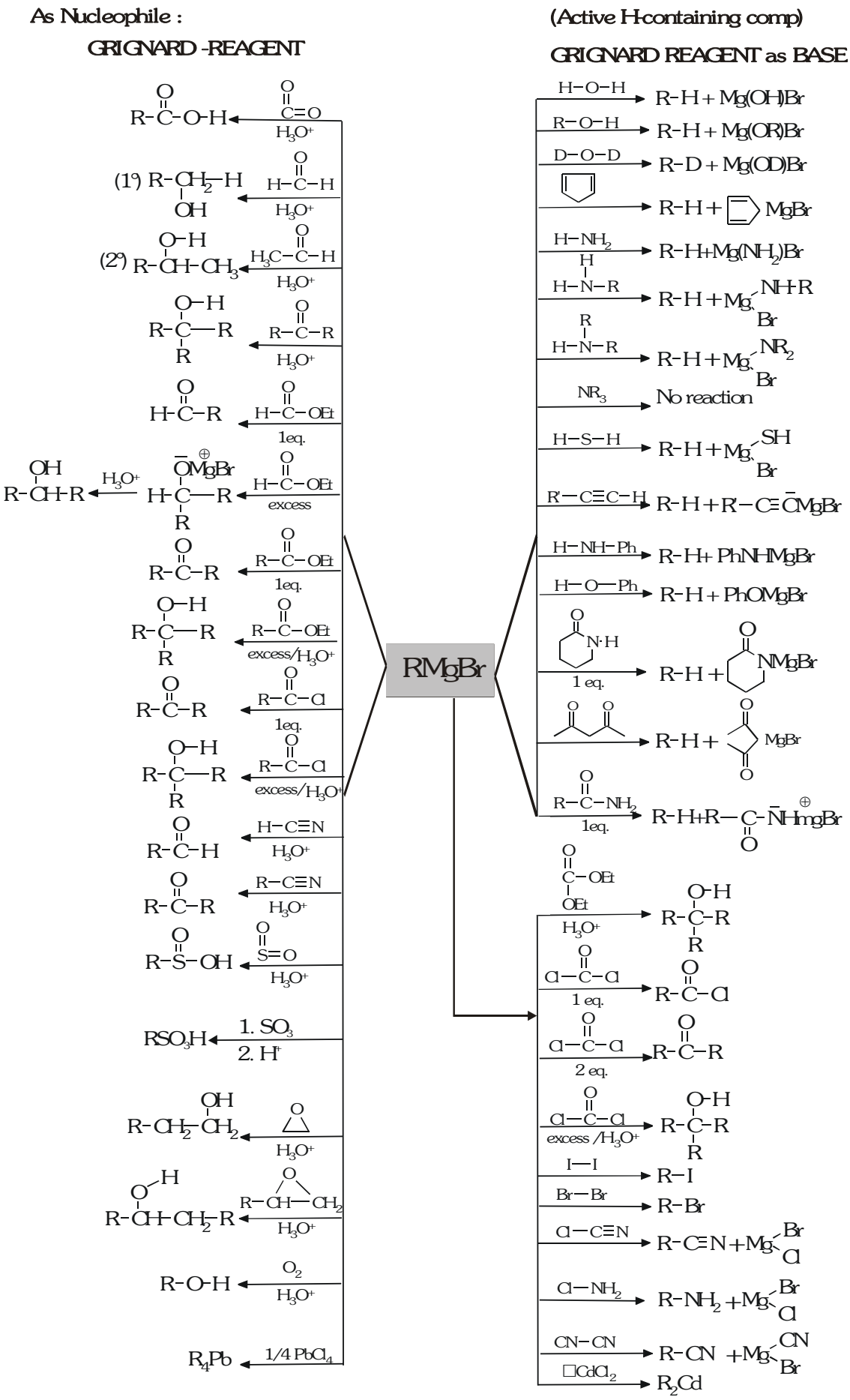


Nutshell review and preview Ether & Epoxides



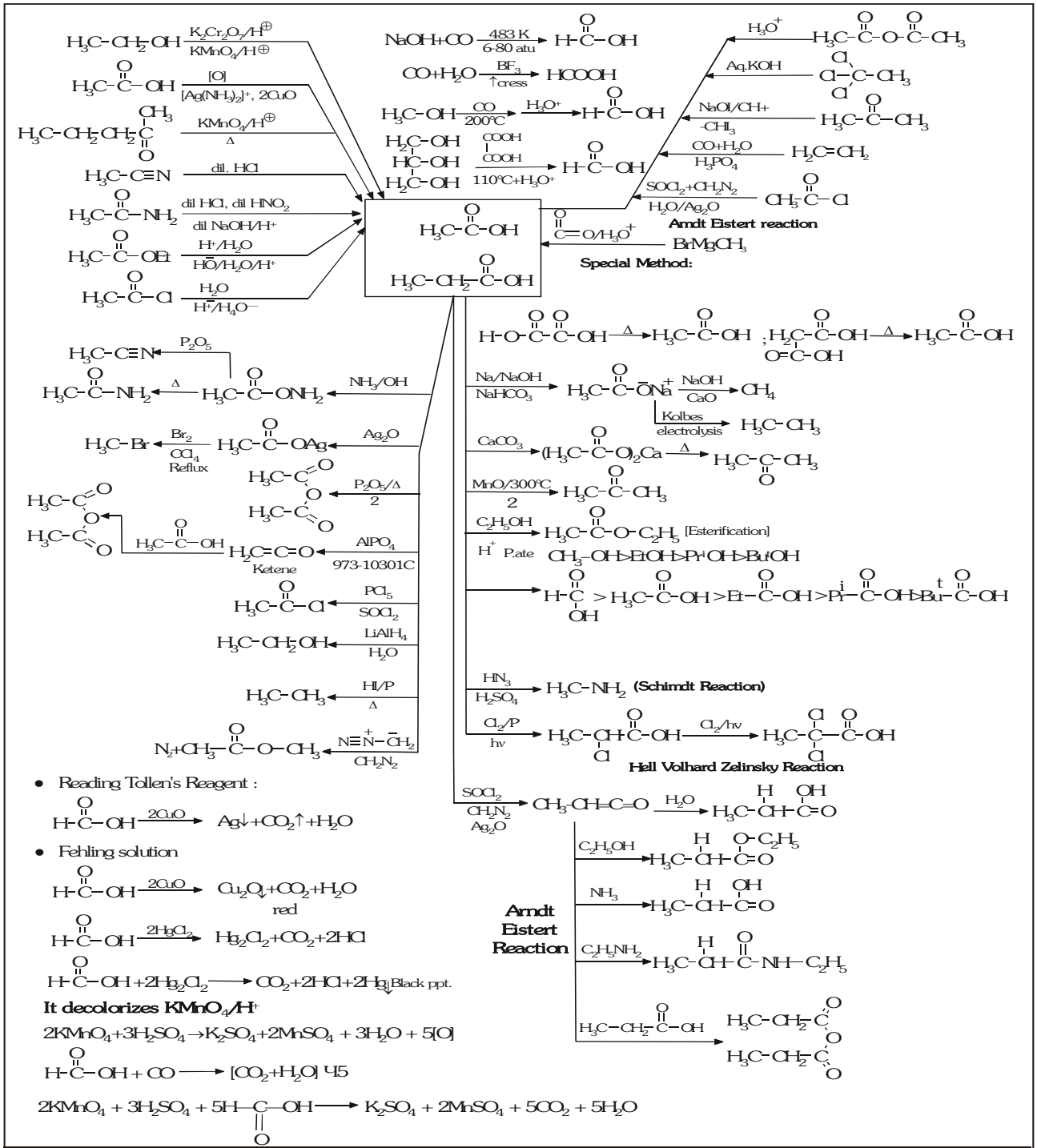
Nutshell preview and review of Carbonyl Reaction



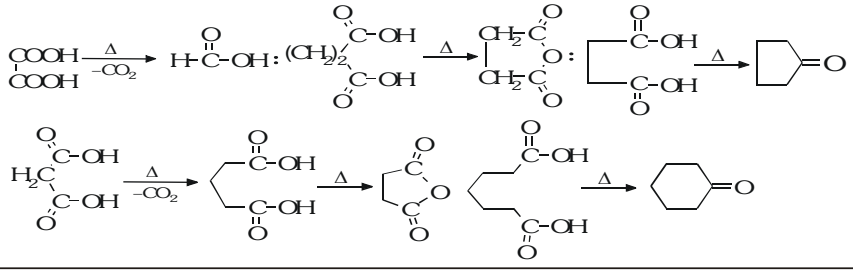

As Nucleophile :
GRIGNARD -REAGENT
(Active H-containing comp)
GRIGNARD REAGENT as BASE
RMgBr
1. SO3
2. H+
1 eq.
2 eq.
excess /H3O+
1/4 PbCl4
No reaction

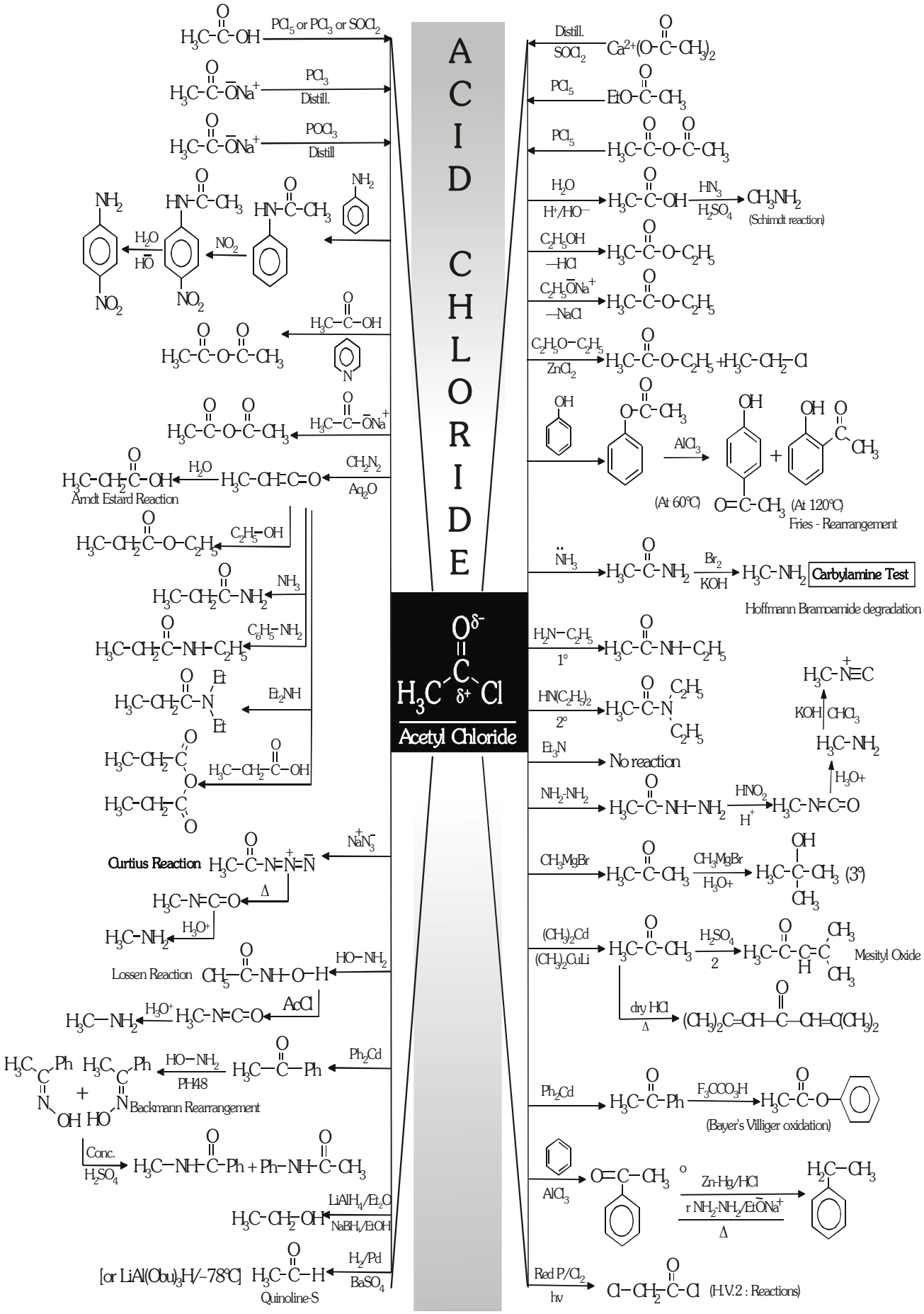
Nutshell preview and review of Carboxylic Acids

PREPARATION & REACTION

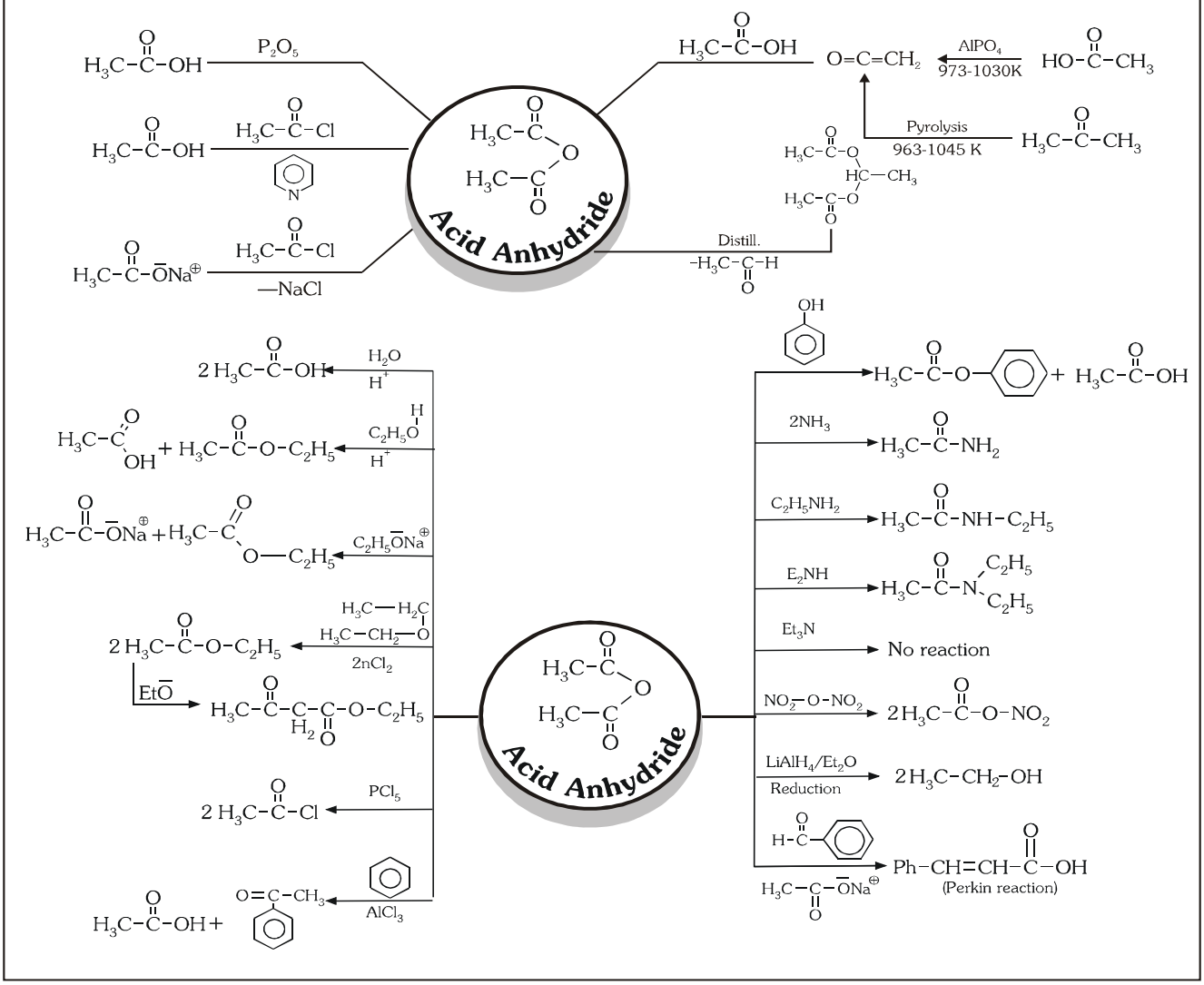


Note : Formic acid does not react with NH_2OH; secarbazide & phenyl / hydraze



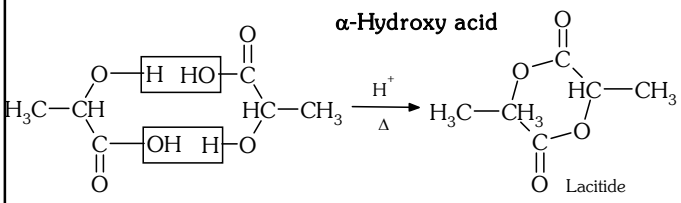

ACID CHLORIDE
Acetyl Chloride
Distill.
SOCl2
Ca2+(O-C-CH3)2
PCl5
EtO-C-CH3
PCl5
H2O
H+/HO−
HN3
H2SO4
CH3NH2
(Schimdt reaction)
C2H5OH
—HCl
C2H5ONa+
—NaCl
C2H5O−C2H5
ZnCl2
+H3C-CH2-Cl
AlCl3
(At 60°C)
(At 120°C)
Fries - Rearrangement
NH3
Br2
KOH
Carbylamine Test
Hoffmann Bramoamide degradation
H2N−C2H5
1°
HN(C2H5)2
2°
Et3N
No reaction
KOH CHCl3
H3O+
NH2-NH2
HNO2
H+
CH3MgBr
(3°)
(CH3)2Cd
(CH3)2CuLi
Mesityl Oxide
dry HCl
Δ
Ph2Cd
F3CCO3H
(Bayer's Villiger oxidation)
AlCl3
Zn-Hg/HCl
r NH2-NH2/EtONa+
Red P/Cl2
hv
(H.V.2 : Reactions)
PCl5 or PCl3 or SOCl2
PCl3
Distill.
POCl3
Distill
NO2
H2O
HO
Arndt Estard Reaction
CH2N2
Ag2O
C2H5-OH
NH3
C6H5-NH2
Et2NH
NaN3
Curtius Reaction
Δ
Lossen Reaction
HO−NH2
AcCl
Backmann Rearrangement
PH48
Conc.
H2SO4
LiAlH4/Et2O
NaBH4/EtOH
[or LiAl(Obu)3H/-78°C]
H2/Pd
BaSO4
Quinoline-S

ACID anhydride

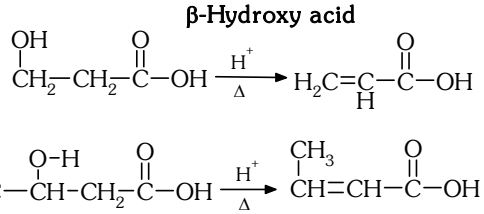


Heating effect

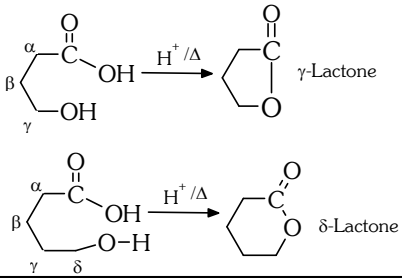
α-Hydroxy acid



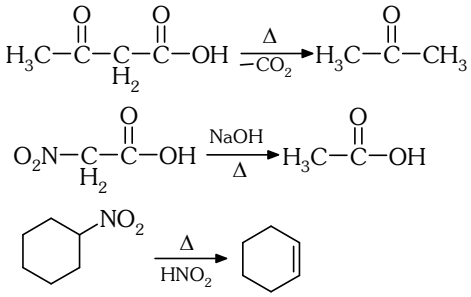
β-Hydroxy acid

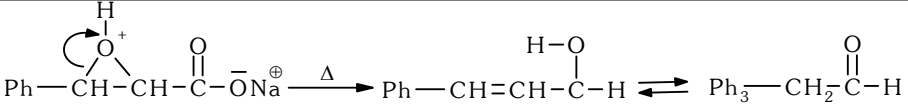


γ & δ–Hydroxy acid

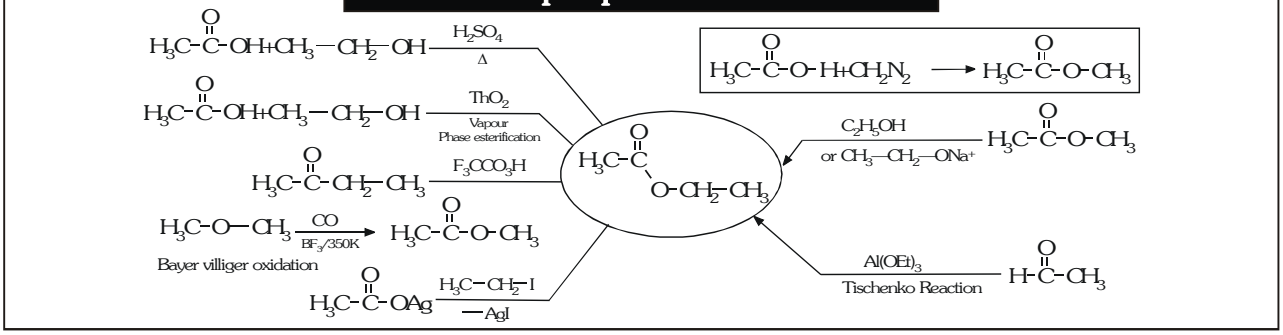


β –Keto acid:

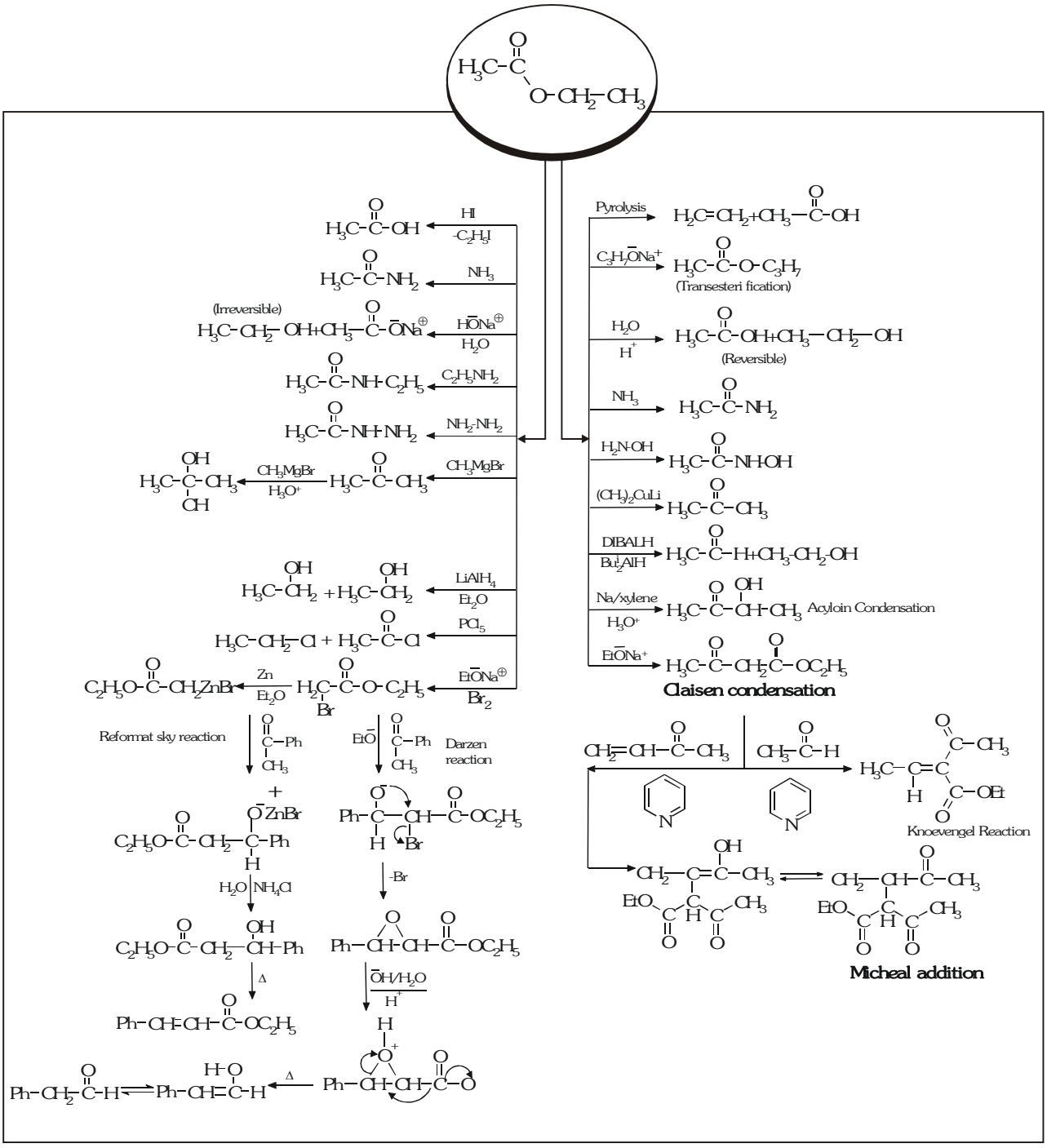




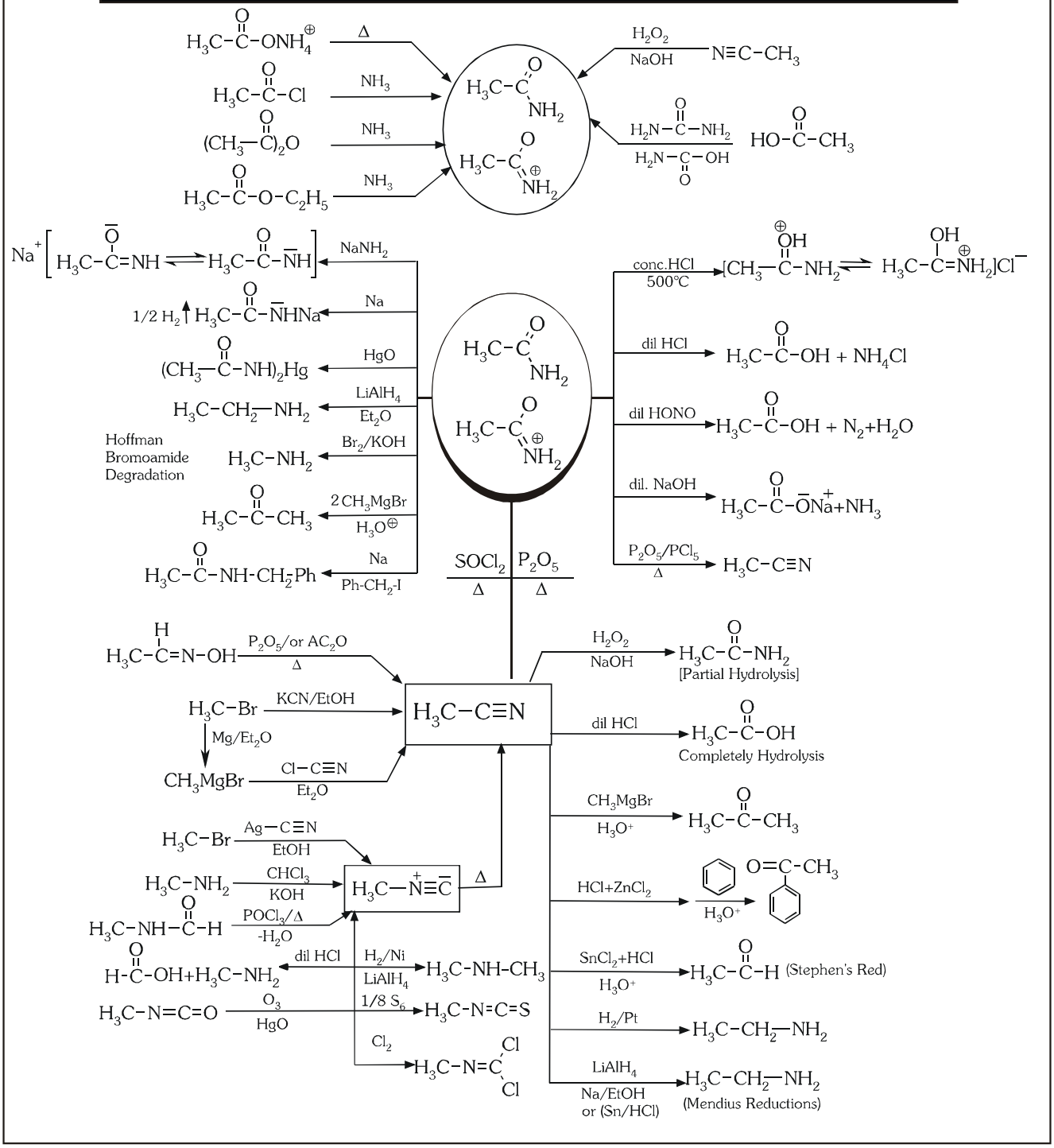
Nutshell preparation of Ester



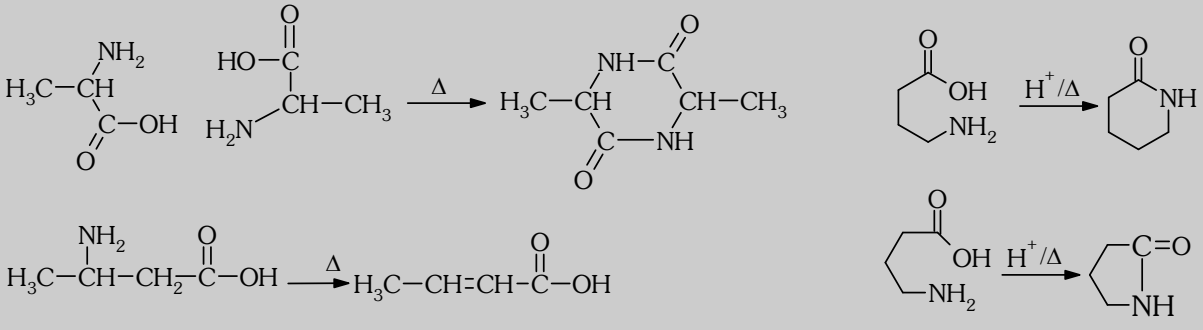
Nutshell chemical properties of Ester



Nutshell preview and review of Amide, Cyanide and Isocyanide

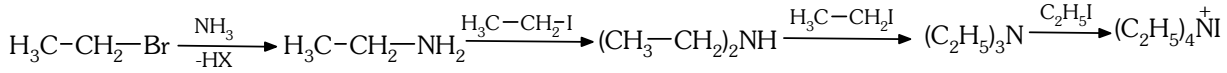


Amino Acid :



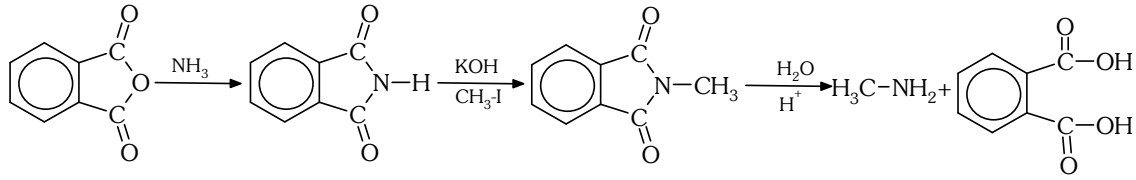
METHOD OF PREPARATION OF AMINE

☐ Hoffmann's Ammonolysis



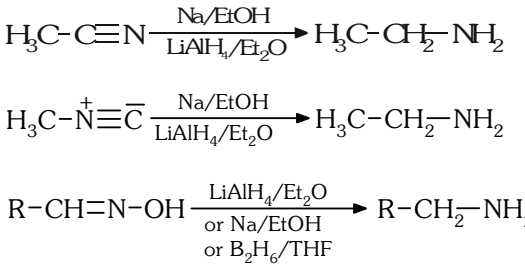
Good yield 1° Amine (If NH_3 1° excess) / Not suitable for Aryl Amine)
Reactivity - R-I > R-Br > R-Cl

☐ Gabriel / Phthalimide Synthesis :

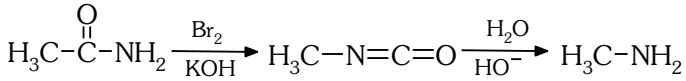


2° & 3° → can't be prepared : Aromatic amine can't prepared

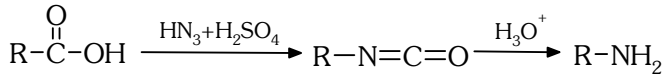
☐ Reduction



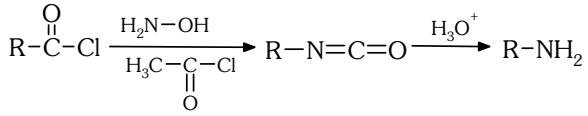
☐ Hoffmann Boroamide Degradation :

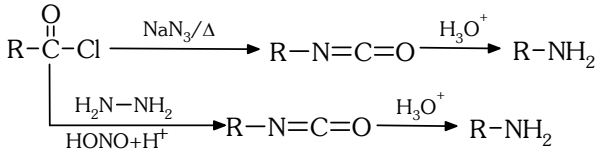


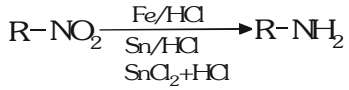
☐ Schimdt Reaction :

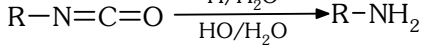


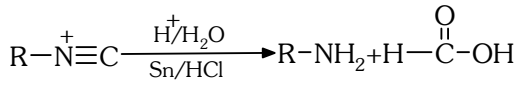
☐ Lossen Reaction

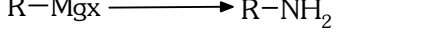




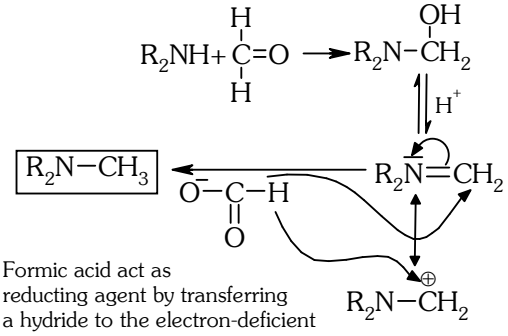






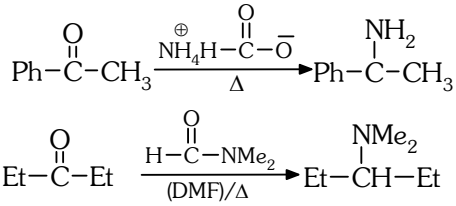


Eschweiler Blarke synthesis

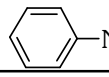
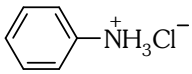
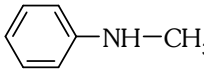
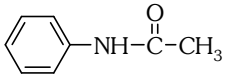
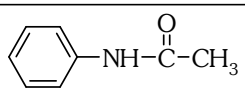
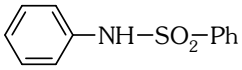
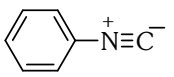
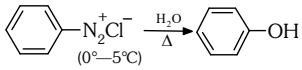
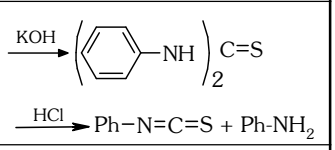
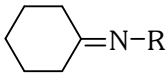
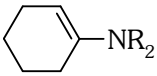
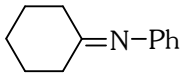


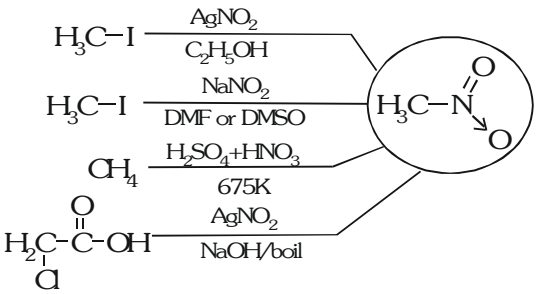
Formic acid act as reducting agent by transferring a hydride to the electron-deficient carbon & is oxidized to CO_2

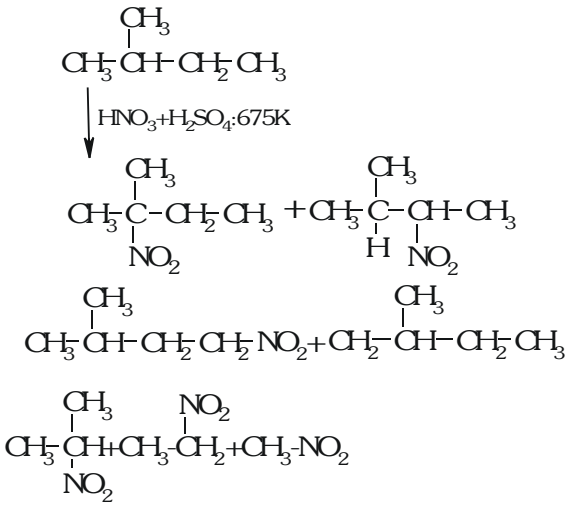
Reductive Amination Leuckart reaction

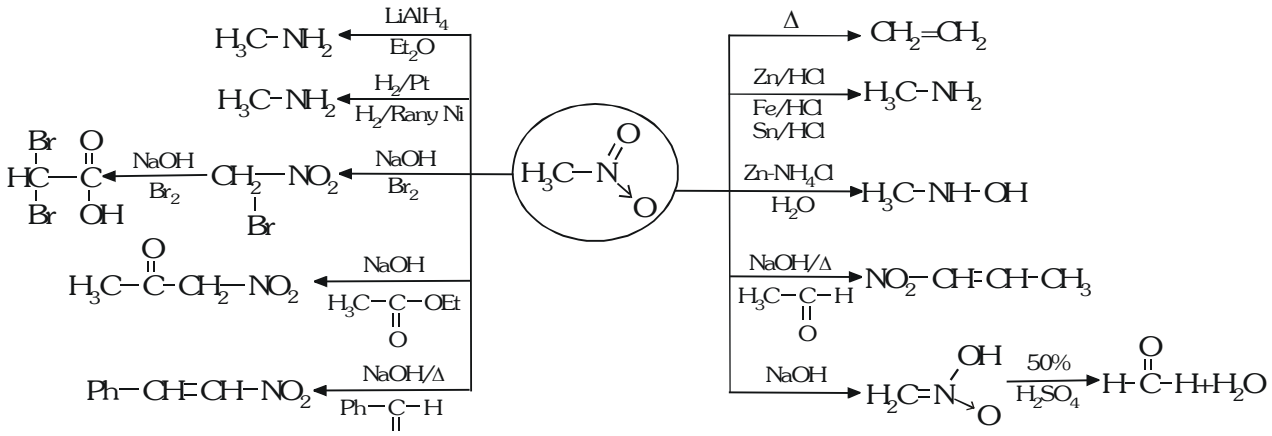


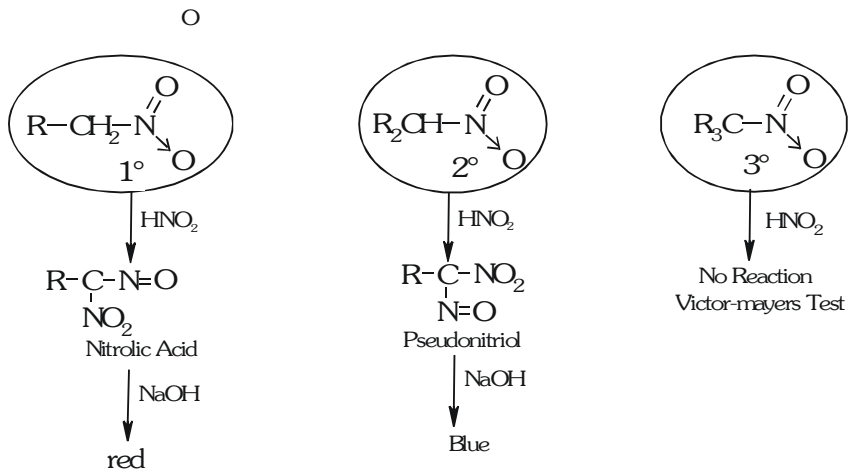
CHEMICAL PROPERTIES OF AMINES

Reagent	$R-\ddot{N}H_2$ (1°)	R_2NH(2°)	R_3N (3°)	
1. HCl	$R-\overset{+}{N}H_3Cl^-$	$R_2\overset{+}{N}H_2Cl^-$	$R_3\overset{+}{N}(H)-Cl^-$	
2. CH_3—Br	R—NH—CH_3	R_2NH—CH_3	$R_3\overset{+}{N}-CH_3Br^-$	
3. $H_3C-\overset{O}{\overset{\|}{C}}-Cl$	$R-NH-\overset{O}{\overset{\|}{C}}-CH_3$	$R_2N-\overset{O}{\overset{\|}{C}}-CH_3$	No reaction	
4. $(CH_3-\overset{O}{\overset{\|}{C}})_2O$	$R-NH-\overset{O}{\overset{\|}{C}}-CH_3$	$R_2N-\overset{O}{\overset{\|}{C}}-CH_3$	No reaction	
5. Ph—SO_2Cl	$R-N(H)-SO_2-Ph$ soluble $\xrightarrow{NaOH}$ $[R-N-SO_2-Ph]Na^+$	$R_2N-\overset{O}{\overset{\|}{S}}-Ph$ $\xrightarrow{NaOH}$ Insoluble	No reaction	
6. Carbylamine Test $CHCl_3/KOH$ ($:CCl_2$)	$R-\overset{+}{N}\equiv C^-$	No reaction	No reaction	
7. HNO=O /H^+	R—OH+N_2+HCl	$R_2N-N=O$	$R_3\overset{+}{N}-H\bar{O}N=O$	
8. **Hoffmann Mustard Oil Test**				
1. $\overset{S}{\overset{\|}{C}}=S$ $\Delta/HgCl_2$	$R-NH-\overset{S}{\overset{\|}{C}}-SH$ R–N=C=S + HgS	$R_2N-\overset{S}{\overset{\|}{C}}-SH$ No reaction	– No reaction	
2. **Hoffmann Test** $COOEt$ $COOEt$	$CONH-R$ $CONH-R$ Oxamide (solid)	$O=C-NR_2$ $COOEt$ Oxamic ester (liquid)	No reaction	$O=C-NH-Ph$ $O=C-NH-Ph$
R'MgX	R'–H+R–NHMgBr	R''H+R_2NMgBr	No reaction	R'H+PhNHMgBr
			No reaction	
$O=C(Cl)Cl$	$(RNH)_2C=O$	$(R_2N)_2C=O$	No reaction	Ph–N=C=O
Ph–N=C=O	$Ph-NH-\overset{O}{\overset{\|}{C}}-NH-R$	$Ph-NH-\overset{O}{\overset{\|}{C}}-N(R)(R)$	No reaction	$Ph-NH-\overset{O}{\overset{\|}{C}}-NH-Ph$
Oxidation	**$R-CH_2-NH_2$**	**R_2NH**	**R_3N**	
$KMnO_4$	$R-CH=NH \xrightarrow{H_3O^+} RCHO$	R_2N-NR_2	No reaction	
H_2SO_5	$R-CH_2-NH-OH$ $R-C(OH)=N-OH$	R_2N-O-H	$R_3N=O$	
$KMnO_4$	**R_2CH-NH_2 :** $R_2C=NH \xrightarrow{H_3O^+} R_2C=O$			
H_2SO_5		$R_3C-NH_2 \xrightarrow{KMnO_4} R_3C-NH_2$		

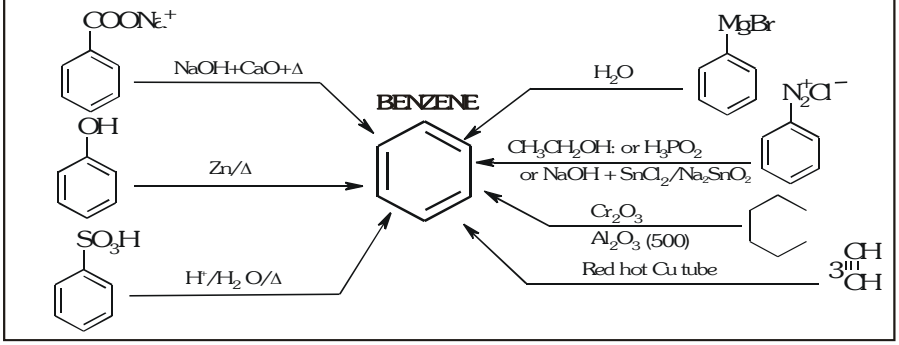

H_3C-I
$AgNO_2$
C_2H_5OH
H_3C-I
$NaNO_2$
DMF or DMSO
CH_4
$H_2SO_4+HNO_3$
675K
$H_2C(Cl)-C(=O)-OH$
$AgNO_2$
NaOH/boil
$H_3C-N(=O)=O$


$CH_3-CH(CH_3)-CH_2-CH_3$
$HNO_3+H_2SO_4$:675K
$CH_3-C(NO_2)(CH_3)-CH_2-CH_3$
$CH_3-CH(H)-CH(NO_2)-CH_3$
$CH_3-CH(CH_3)-CH_2-CH_2-NO_2$
$CH_3-CH(CH_3)-CH_2-CH_3$
$CH_3-CH(NO_2)-CH_3$
$CH_3-CH_2-NO_2$
CH_3-NO_2


H_3C-NH_2
$LiAlH_4$
Et_2O
H_3C-NH_2
H_2/Pt
H_2/Rany Ni
$HC(Br)_2-C(=O)-OH$
NaOH
Br_2
$CH_2(Br)-NO_2$
NaOH
Br_2
$H_3C-C(=O)-CH_2-NO_2$
NaOH
$H_3C-C(=O)-OEt$
$Ph-CH=CH-NO_2$
NaOH/Δ
$Ph-C(=O)-H$
$H_3C-N(=O)=O$
Δ
$CH_2=CH_2$
Zn/HCl
Fe/HCl
Sn/HCl
H_3C-NH_2
$Zn-NH_4Cl$
H_2O
$H_3C-NH-OH$
NaOH/Δ
$H_3C-C(=O)-H$
$NO_2-CH=CH-CH_3$
NaOH
$H_2C=N(OH)=O$
50%
H_2SO_4
$H-C(=O)-H+H_2O$

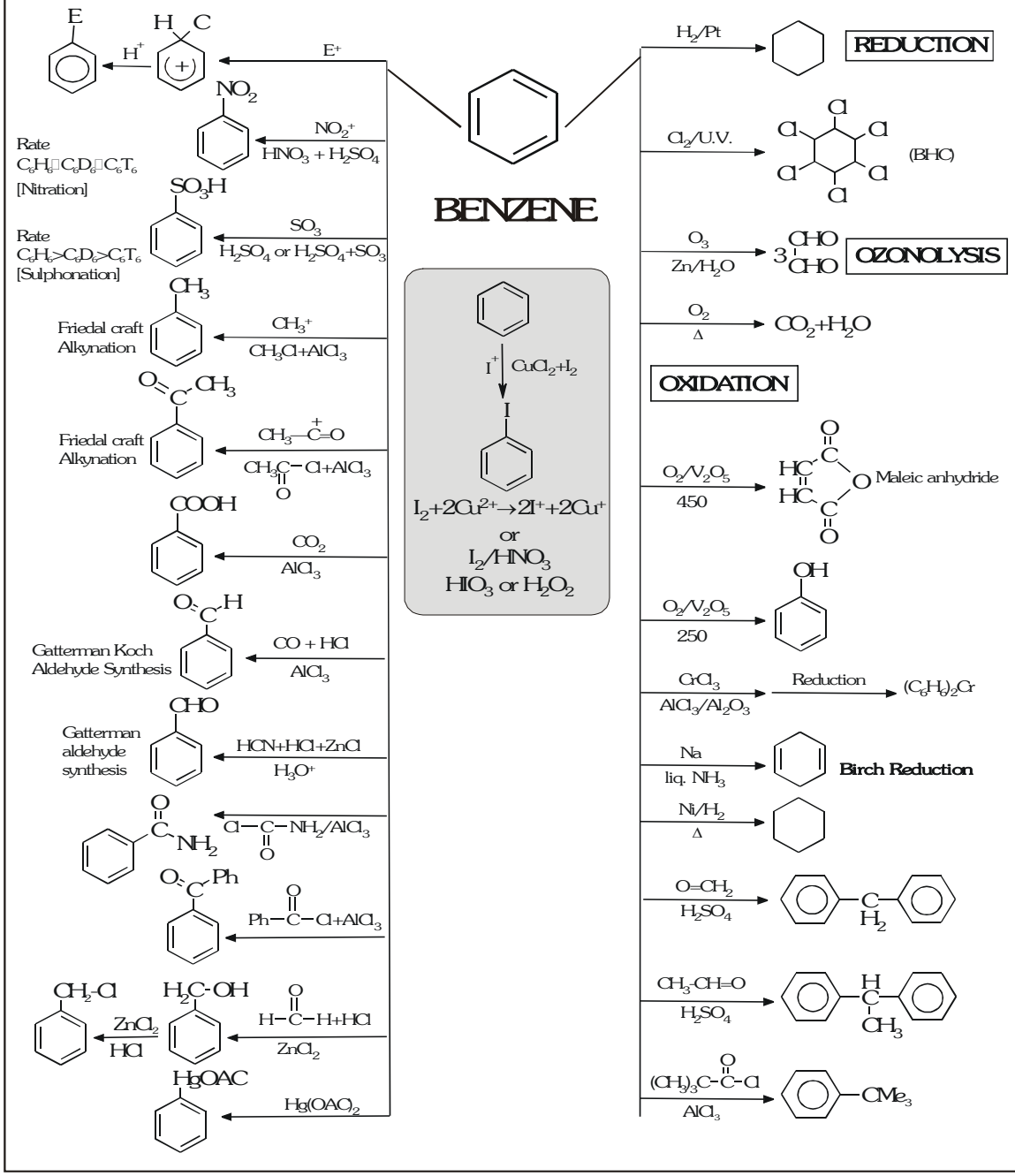

$R-CH_2-N(=O)=O$
1°
HNO_2
$R-C(NO_2)=N-OH$
Nitrolic Acid
NaOH
red
$R_2CH-N(=O)=O$
2°
HNO_2
$R-C(NO_2)=N-OH$
Pseudonitriol
NaOH
Blue
$R_3C-N(=O)=O$
3°
HNO_2
No Reaction
Victor-mayers Test

Nutshell Preparation of Benzene

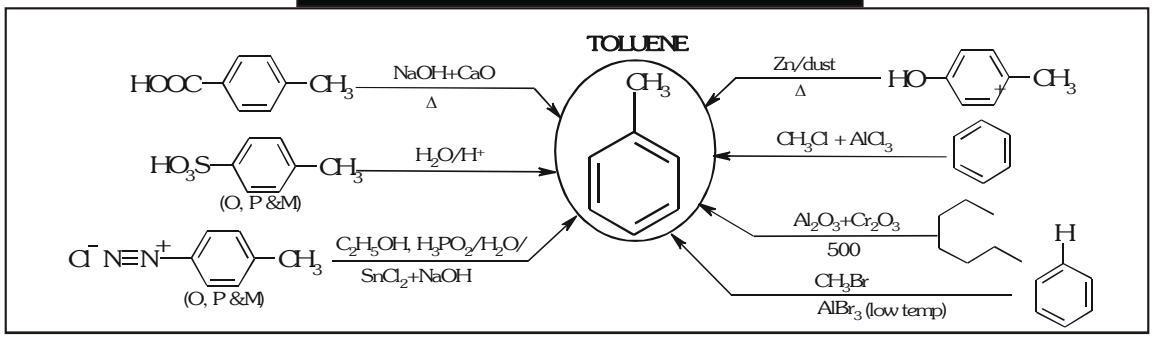


Nutshell Review and Preview of Benzene Reactions

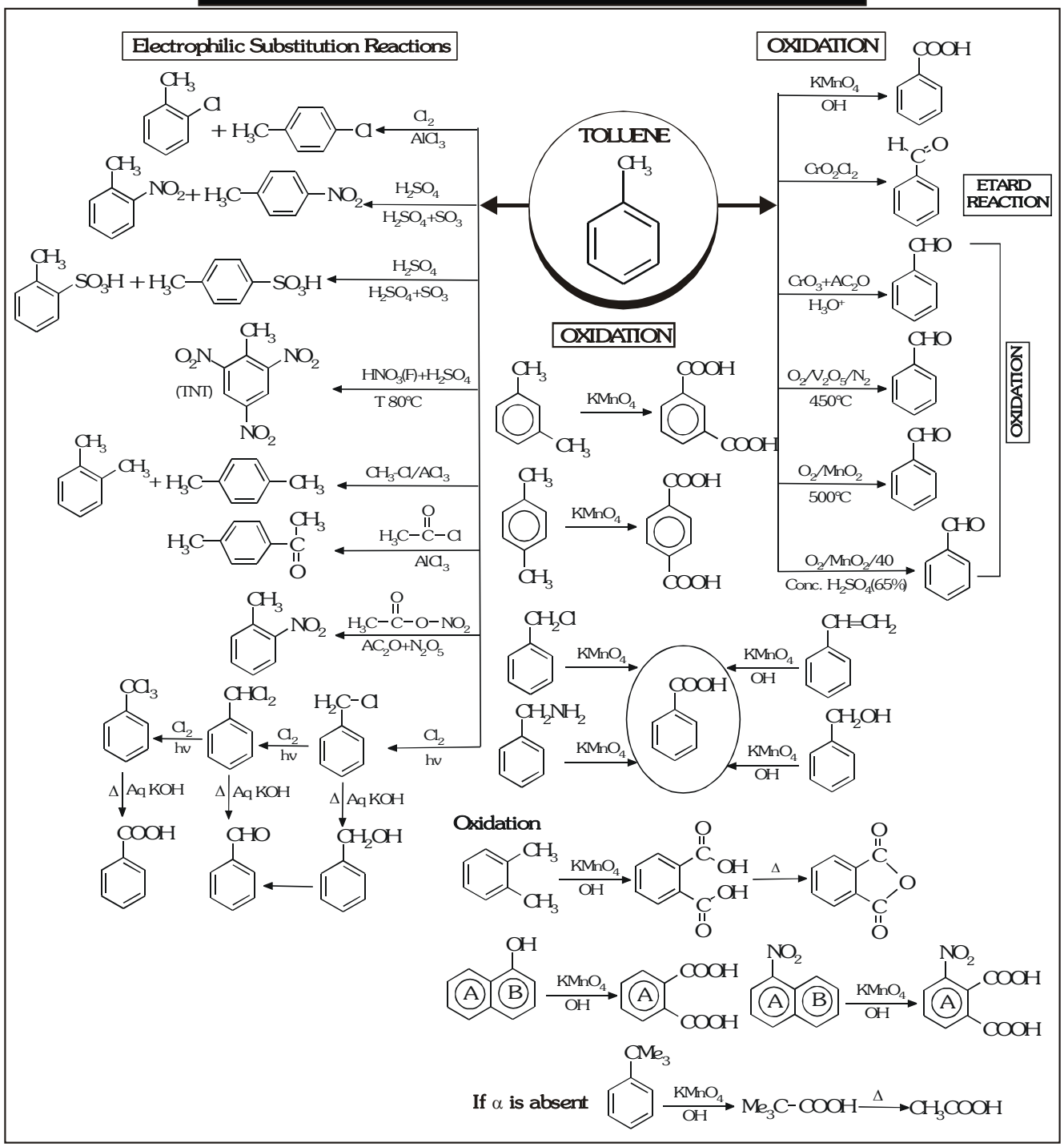
Electrophilic Substitution Reactions



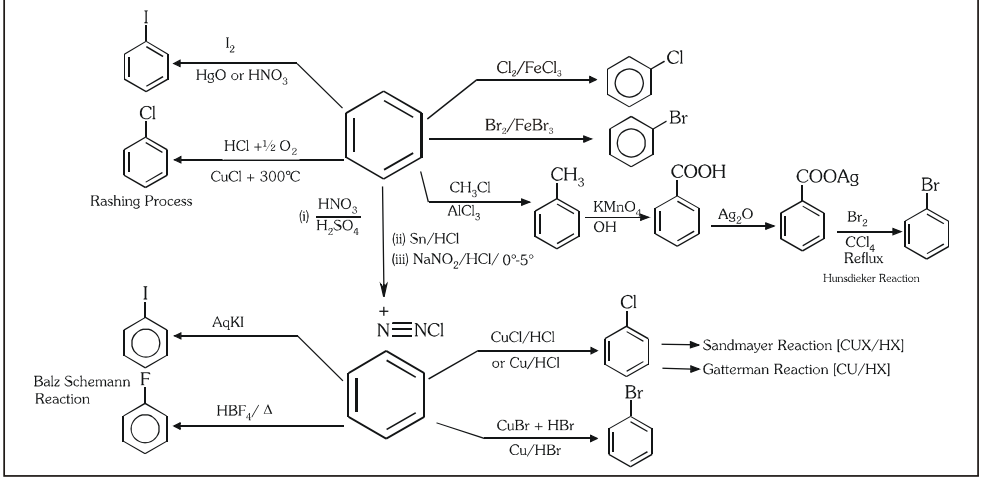
Nutshell Preparation of Toluene



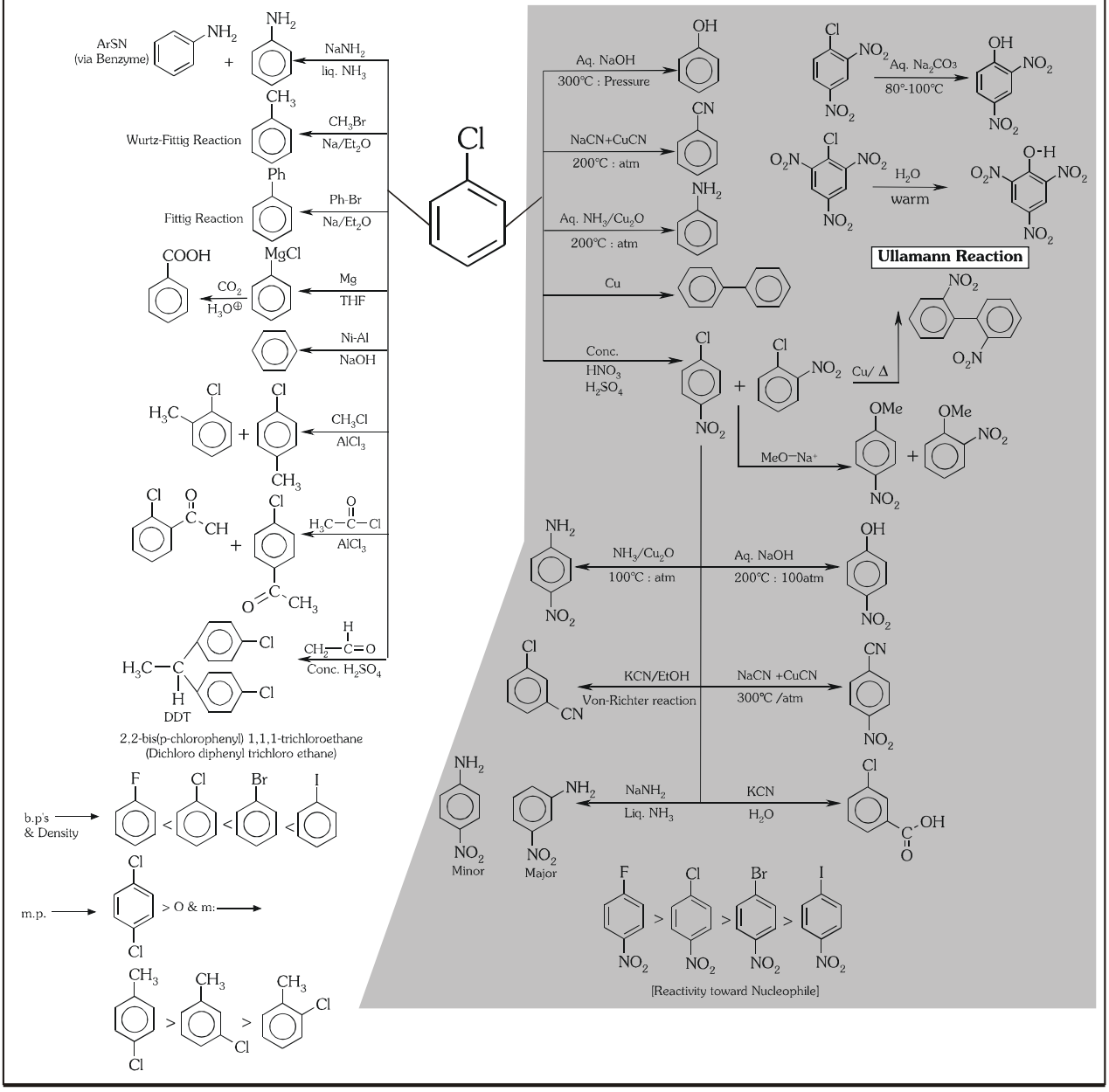
Nutshell Review and Preview of Toluene Reactions



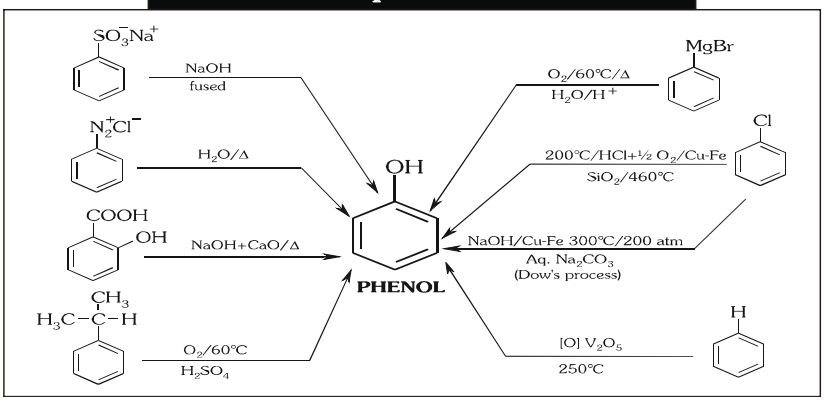
Nut Shell preparation 'Aromatic Halogen Compound'



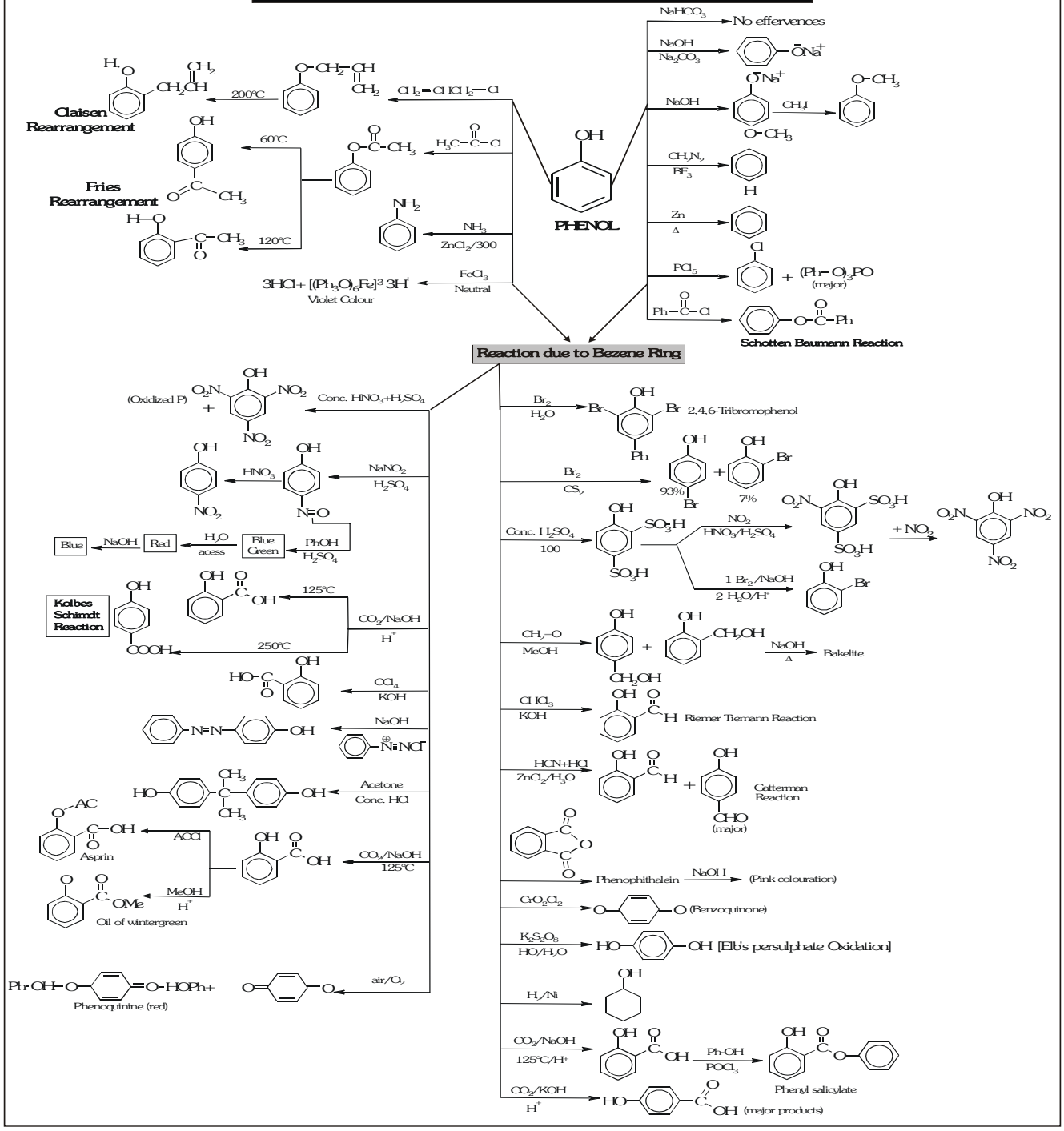
Nutshell review and Preview of Aromatic Halogen Reactions

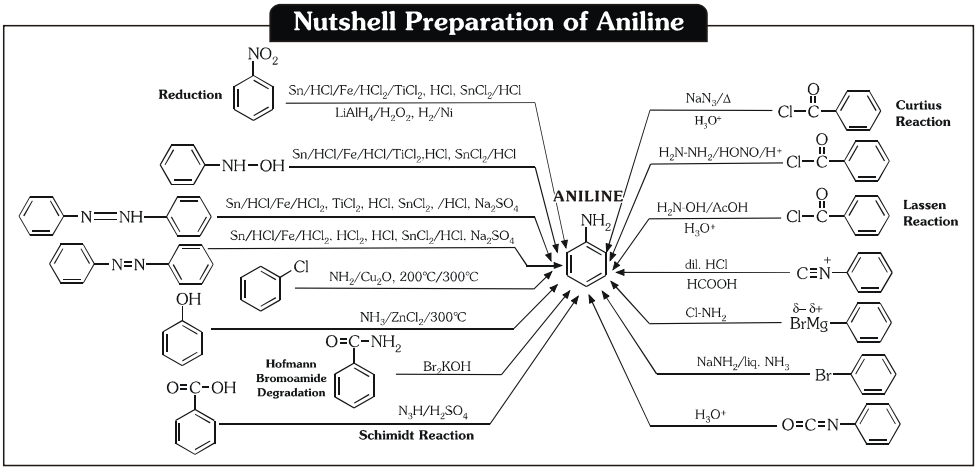


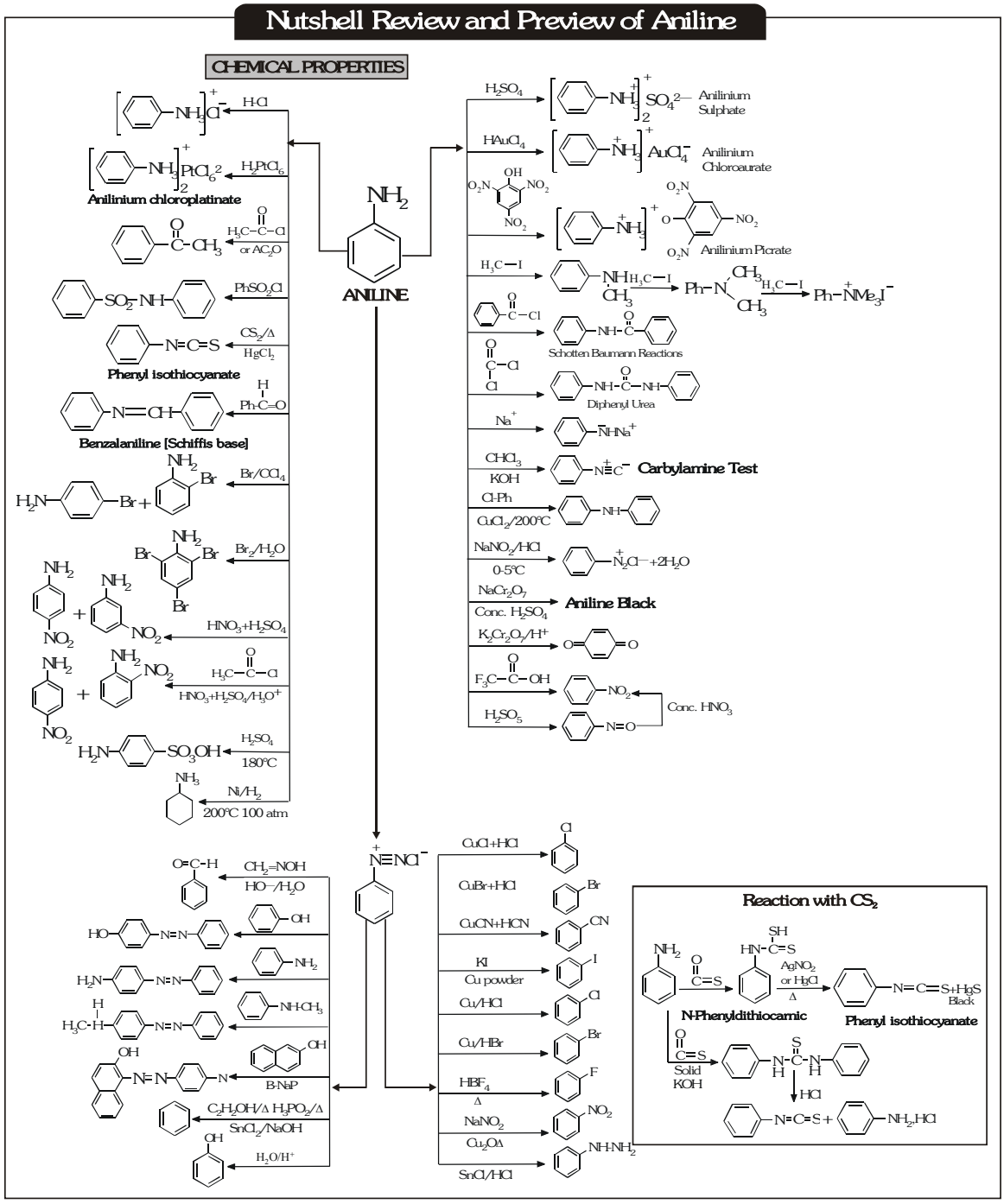
Nutshell Preparation of Phenol



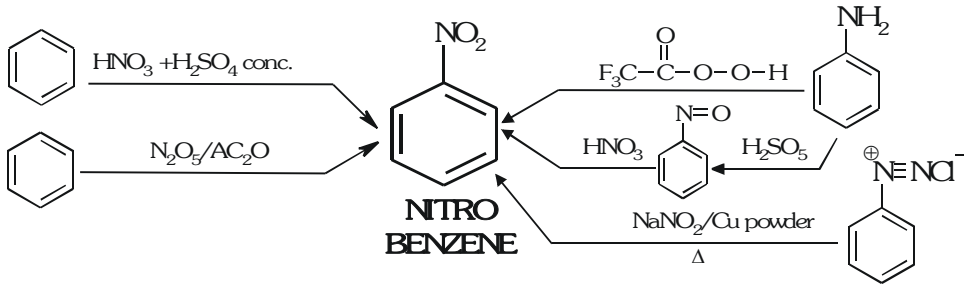
Nutshell Review and Preview Phenol Reactions




Nutshell Preparation of Aniline
Reduction
Sn/HCl/Fe/HCl2/TiCl2, HCl, SnCl2/HCl
LiAlH4/H2O2, H2/Ni
Sn/HCl/Fe/HCl/TiCl2,HCl, SnCl2/HCl
Sn/HCl/Fe/HCl2, TiCl2, HCl, SnCl2, /HCl, Na2SO4
Sn/HCl/Fe/HCl2, HCl, HCl, SnCl2/HCl, Na2SO4
NH2/Cu2O, 200°C/300°C
NH3/ZnCl2/300°C
Hofmann Bromoamide Degradation
Br2KOH
N3H/H2SO4
Schimidt Reaction
ANILINE
NaN3/Δ
H3O+
Curtius Reaction
H2N-NH2/HONO/H+
H2N·OH/AcOH
Lassen Reaction
dil. HCl
HCOOH
Cl-NH2
NaNH2/liq. NH3
H3O+

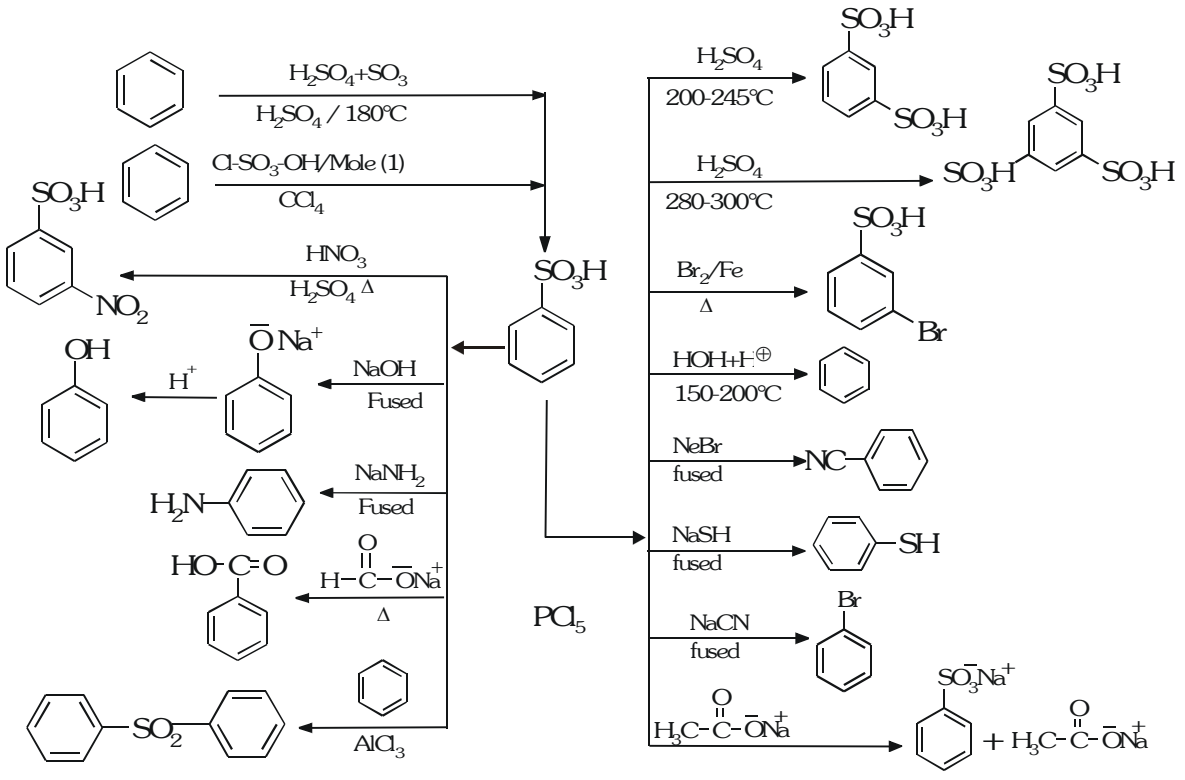

Nutshell Review and Preview of Aniline
CHEMICAL PROPERTIES
ANILINE
Anilinium chloroplatinate
Phenyl isothiocyanate
Benzalaniline [Schiffis base]
Anilinium Sulphate
Anilinium Chlorcaurate
Anilinium Picrate
Schotten Baumann Reactions
Diphenyl Urea
Carbylamine Test
Aniline Black
Conc. HNO3
B-NaP
Reaction with CS2
N-Phenyldithiocarnic
Phenyl isothiocyanate
Solid KOH
Black

Nutshell Preparation of Nitro Benzene

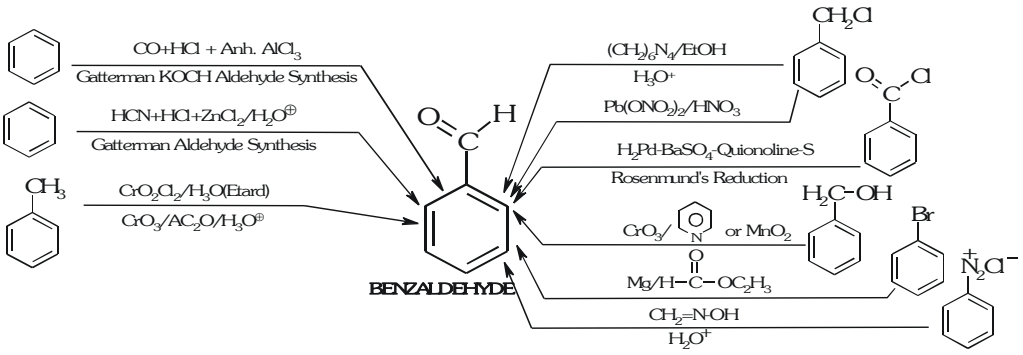


Nutshell Sulphonic Acid

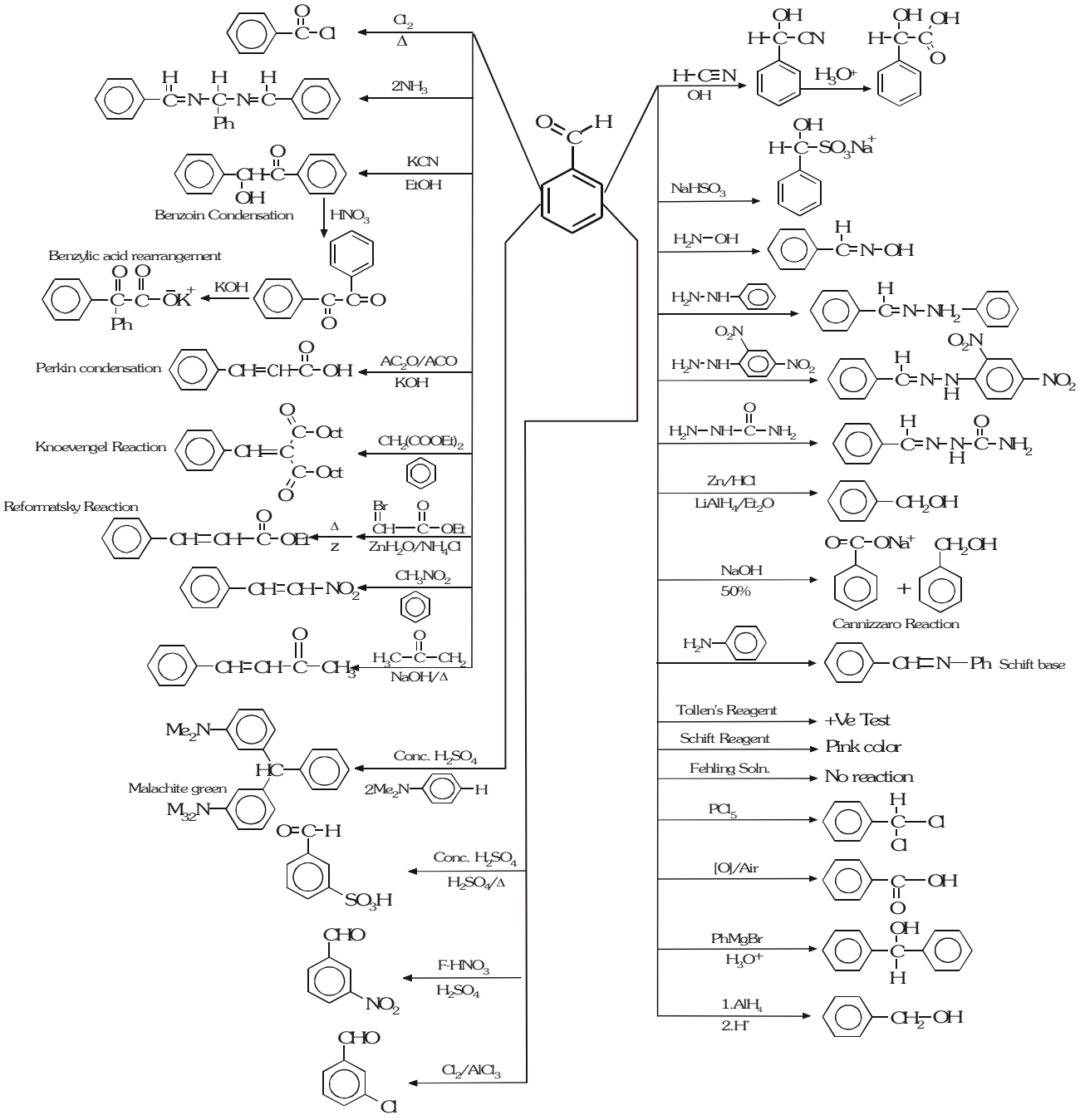
BENZENE SULPHONIC ACID



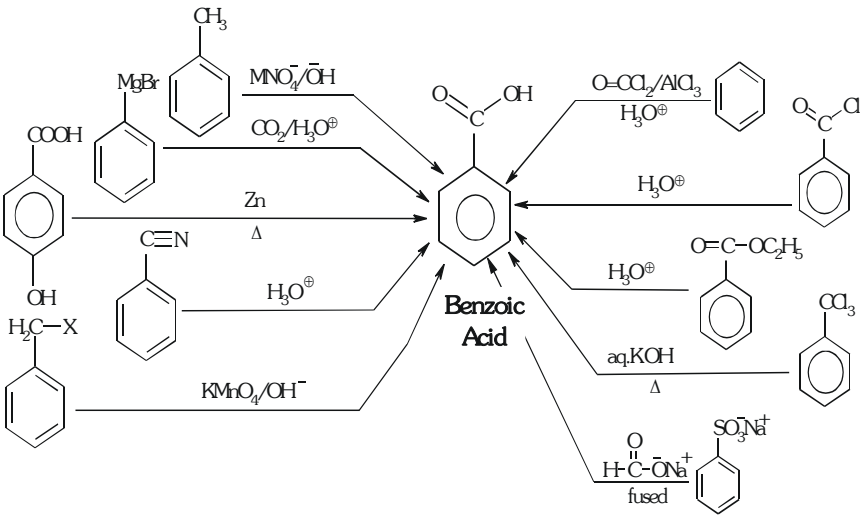
Nutshell Preparation of Benzaldehyde



Nutshell Review and Review of Benzaldehyde Reactions



NUTSHELL PREPARATION OF BENZOIC ACID



NUTSHELL REVIEW AND PREVIEW OF BENZOIC ACID REACTIONS