GENERAL ORGANIC CHEMISTRY

Electrophiles are electron deficient species.

eg. $H^{\oplus}$, $R^{\oplus}$, $NO_2^{\oplus}$, $X^{\oplus}$, PCl_3, PCl_5

($\overset{\oplus}{N}H_4$ and $H_3O^{\oplus}$ are not electrophile)

Nucleophiles are electron rich species.

e.g. $Cl^{\ominus}$, $\overset{\ominus}{C}H_3$, $\overset{\ominus}{O}H$, $RO^{\ominus}$, $\overset{\ominus}{C}N$, $\ddot{N}H_3$, $R\ddot{O}H$, $CH_2{=}CH_2$, $CH{\equiv}CH$

Relative electron withdrawing order (–I order)

$-\overset{\oplus}{N}F_3 > -\overset{\oplus}{N}R_3 > -\overset{\oplus}{N}H_3 > -NO_2 > -CN > -COOH > -X > -OR > -OH > -C{\equiv}CH > -NH_2 > -C_6H_5 > -CH = CH_2$

Relative electron releasing order (+I order)

$-\overset{\ominus}{N}H > -O^{\ominus} > -COO^{\ominus} >$ 3°alkyl > 2°alkyl > 1° alkyl > $-CH_3$

RELATIVE STABILITY ORDER

(A) Stability of carbocation

 $> (Ph)_3\overset{\oplus}{C} > (Ph)_2\overset{\oplus}{C}H > Ph-\overset{\oplus}{C}H_2 > CH_2 = CH-\overset{\oplus}{C}H_2 >$

$(CH_3)_3\overset{\oplus}{C} > (CH_3)_2\overset{\oplus}{C}H > CH_3\overset{\oplus}{C}H_2 > \overset{\oplus}{C}H_3 > CH_2 = \overset{\oplus}{C}H > CH \equiv \overset{\oplus}{C}$

(B) Stability of free radical

$(Ph)_3\dot{C} > (Ph)_2\dot{C}H > Ph\dot{C}H_2 > CH_2 = CH-\dot{C}H_2 >$

$(CH_3)_3\dot{C} > (CH_3)_2\dot{C}H > CH_3\dot{C}H_2 > \dot{C}H_3$

(C) Stability of Carbanion

$(Ph)_3\overset{\ominus}{C} > (Ph)_2\overset{\ominus}{C}H > Ph-\overset{\ominus}{C}H_2 > CH_2 = CH-\overset{\ominus}{C}H_2 >$

$\overset{\ominus}{C}H_3 > CH_3\overset{\ominus}{C}H_2 > (CH_3)_2\overset{\ominus}{C}H > (CH_3)_3\overset{\ominus}{C}$

BASIC STRENGTH $\propto K_b \propto \frac{1}{pK_b}$

- ***Basic strength of amine :-***

  In aqueous medium

  $R \Rightarrow -CH_3$ 2° > 1° > 3° > NH_3

  $R \Rightarrow -CH_2CH_3$ 2° > 3° > 1° > NH_3

  In gaseous medium

  $R \Rightarrow -CH_3$ 3° > 2° > 1° > NH_3

  $R \Rightarrow -CH_2CH_3$ 3° > 2° > 1° > NH_3

- ***Reactivity towards nucleophile (NAR)***

  (1) $HCHO > CH_3CHO > (CH_3)_2CO$

  (2) $CCl_3CHO > CHCl_2CHO > CH_2ClCHO$

- ***Reactivity order towards acyl nucleophilic substitution reaction***

  Acid chloride > anhydride > ester > amide

- ***Order of electronic effect***

  Mesomeric > Hyperconjugation > Inductive effect

- ***Stability of alkene ∝ no. of α-hydrogen***

$R_2C{=}CR_2 > R_2C{=}CHR > R_2C{=}CH_2 > \underset{\text{trans form}}{RCH{=}CHR} > \underset{\text{cis form}}{RCH{=}CHR}$

$RCH{=}CH_2 > CH_2{=}CH_2$

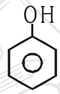
- ***Heat of hydrogenation*** $\propto \frac{1}{\text{Stability of alkene}}$

ACIDIC STRENGTH ∝ *Stability of conjugate base*

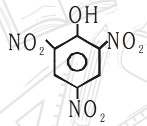
$\propto K_a \propto \frac{1}{pK_a}$

(i) $H_2O > CH \equiv CH > NH_3$

(ii) $CH \equiv CH > CH_2 = CH_2 > CH_3{-}CH_3$

(iii) $R{-}SO_3H > R{-}COOH >$  $> R{-}OH$

(iv) $HCOOH > CH_3COOH > CH_3CH_2COOH$

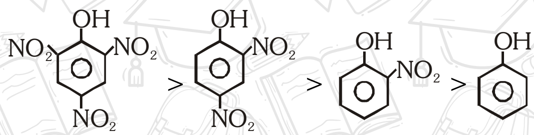
(v)  $> HCOOH > C_6H_5COOH > CH_3COOH$

(vi) $CCl_3COOH > CHCl_2COOH > CH_2ClCOOH$

(vii) $CH_3{-}CH_2{-}\underset{F}{CH}{-}COOH > CH_3{-}\underset{F}{CH}{-}CH_2COOH > \underset{F}{CH_2}{-}CH_2CH_2COOH$

(viii) $C_6H_4(OH)(CH_3)$ Phenol > m > p > o

(ix) $C_6H_4(OH)(NO_2)$ p > o > m > Phenol

(x) 

(xi) $C_6H_4(COOH)(NO_2)$ o > p > m > benzoic acid

(xii) $C_6H_4(COOH)(CH_3)$ o > benzoic acid > m > p

(xiii) $C_6H_4(COOH)(Cl)$ o > m > p > benzoic acid

PURIFICATION OF ORGANIC CHEMISTRY

PURIFICATION METHODS

DISTILLATION TECHNIQUES

Type :

(A) SIMPLE DISTILLATION

Conditions

(i) When liquid sample has non volatile impurities

(ii) When boiling point difference is 80 K or more.

Examples

(i) Mixture of chloroform (BP = 334K) and Aniline (BP = 457K)

(ii) Mixture of Ether (b.p. = 308K) & Toluene (b.p. = 384K)

(iii) Hexane (342K) and Toulene(384K)

(B) FRACTIONAL DISTILLATION

When b.p. difference is 10K

Examples

(i) Crude oil in petroleum industry

(ii) Acetone (329 K) and Methyl alcohol (338K)

(C) DISTILLATION UNDER REDUCED PRESSURE (Vacuum distillation)

When liquid boils at higher temperature and it may decompose before b.p. is attained.

Example (i) Concentration of sugar juice

(ii) Recovery of glycerol from spent lye.

(iii) Glycerol

(D) STEAM DISTILLATION

When the substance is immiscible with water and steam volatile.

P	=	P_1	+	P_2
Vapour pressure		Vapour pressure of Organic liquid		Vapour pressure of water

Example :

(i) Aniline is separated from water

(ii) Turpentine oil

(iii) Nitro Benzene

(iv) Bromo Benzene

(v) Naphthalene

(vi) o-Nitrophenol

LASSAIGNE'S METHOD (detection of elements)

Element	Sodium extract	Confirmed test
Nitrogen	$Na + C + N \xrightarrow{\Delta} NaCN$	$(NaCN + FeSO_4 + NaOH)$ boil and cool $+ FeCl_3 + \text{conc. } HCl \rightarrow Fe_4[Fe(CN)_6]_3$ Prussian blue colour
Sulphur	$2Na + S \xrightarrow{\Delta} Na_2S$	(i) $Na_2S + Na_2[Fe(CN)_5NO]$ sodium nitrosopruside $\rightarrow Na_4[Fe(CN)_5NOS]$ a deep violet colour (ii) $Na_2S + CH_3COOH + (CH_3COO)_2Pb \rightarrow PbS\downarrow$ Black ppt.
Halogen	$Na + X \xrightarrow{\Delta} NaX$	$NaX + HNO_3 + AgNO_3$ (i) White ppt. soluble in aq. NH_3 confirms Cl. (ii) Yellow ppt. partially soluble in aq. NH_3 confirms Br. (iii) Yellow ppt. insoluble in aq. NH_3 confirms I.
Nitrogen and sulphur together	$Na + C + N + S \xrightarrow{\Delta} NaCNS$ Sodium thiocyanate (Blood red colour)	As in test for nitrogen; instead of green or blue colour, blood red colouration confirms presence of N and S both

QUANTITATIVE ANALYSIS OF ORGANIC COMPOUNDS

Estimation of carbon and hydrogen - Leebig's method

Note : This method is suitable for estimation if organic compound contains C and H only. In case if other elements e.g., N, S, halogens are also present the organic compound will also give their oxides which is being absorbed in KOH and will increase the percentage of carbon and therefore following modification should be made.

ESTIMATION OF NITROGEN

Duma's method :

The nitrogen containing organic compound yields nitrogen gas on heating it with copper (II) oxide in the presence of CO_2 gas. The mixture of gases is collected over potassium hydroxide solution in which CO_2 is absorbed and volume of nitrogen gas is determined.

Note : This method can be used to estimate nitrogen in all types of organic compounds

Kjeldahl's method :

In this method nitrogen containing compound is heated with conc. H_2SO_4 in presence of copper sulphate to convert nitrogen into ammonium sulphate which is decomposed with excess of alkali to liberate ammonia.

Note : This method is simpler and more convenient and is mainly used for finding out the percentage of nitrogen in food stuffs, soil, fertilizers and various agricultural products. This method cannot be used for compound having nitro groups, azo group (–N = N–) and nitrogen in the ring (pyridine, quinole etc.) Since nitrogen in these compounds is not quantitatively converted in to ammonium sulphate.

PRACTICAL ORGANIC CHEMISTRY

UNSATURATION TEST

(a) Double/Triple bonded Compounds (C = C)/(C ≡ C) + Br_2 in CCl_4 (Brown colour) → Colourless compound

- $R-CH=CH-R + Br_2 \xrightarrow{CCl_4} R-CH(Br)-CH(Br)-R$
  (Alkene) (Brown) (Colourless)

- $R-C\equiv C-R + Br_2 \xrightarrow{CCl_4} R-C(Br)_2-C(Br)_2-R$
  (Alkyne) (Brown) (Colourless)

(b) Double/Triple bonded Compounds + Baeyer's reagent (Pink colour) ⟶ Brown precipitate

- $R-CH=CH-R + KMnO_4 \longrightarrow R-CH(OH)-CH(OH)-R + MnO_2$
  (Alkene) (Cold, dilute) (Colourless) Brown ppt
- $R-C\equiv C-R' + KMnO_4 \longrightarrow MnO_2 + RCOOH + R'COOH$
  (Hot, dilute) Brown ppt.
- $R-C\equiv C-H + KMnO_4 \longrightarrow MnO_2 + RCOOH + CO_2 + H_2O$
  (Alkyne) (Hot, dilute) Brown ppt. (Colourless)

Baeyer's reagent is cold, dilute $KMnO_4$ solution having pink colour.

Note : The above test are not given by Benzene. Although it has unsaturation.

TEST FOR TERMINAL ALKYNE

Terminal alkyne
- Ammonical silver nitrate → White ppt.
- Ammonical cuprous chloride → Red ppt.

$R-C\equiv CH$ (Terminal alkyne) $\xrightarrow{AgNO_3 + NH_4OH} NH_4NO_3 + H_2O + R-C\equiv C-Ag$ (White ppt.)

$R-C\equiv CH$ (Terminal alkyne) $\xrightarrow{Cu_2Cl_2 + NH_4OH} NH_4Cl + H_2O + R-C\equiv C-Cu$ (Red ppt.)

NATURE OF X-GROUP IN C–X BOND

$R-X + \text{aqueous } KOH \longrightarrow R-OH + KX \xrightarrow[AgNO_3]{HNO_3} AgX$
Precipitate

If X is Cl, precipitate will be white and for Br yellow precipitate will be obtained.

DISTINCTION BETWEEN 1°, 2° & 3° ALCOHOLS

- $R-C(R)_2-OH \xrightarrow[\text{Room temperature}]{\text{Lucas reagent}} R-C(R)_2-Cl$
  Tertiary alcohol — Cloudiness appears immediately
- $R-CH(R)-OH \xrightarrow[\text{Room temperature}]{\text{Lucas reagent}} R-CH(R)-Cl$
  Secondary alcohol — Cloudiness appears within five minutes
- $R-CH_2-OH \xrightarrow[\text{Heat}]{\text{Lucas reagent}} R-CH_2-Cl$
  Primary alcohol — Cloudiness appears after 30 minute

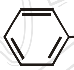
Lucas reagent is anhydrous $ZnCl_2$ + conc. HCl.

HALOFORM REACTION IN ALCOHOL

- $H_3C-CH(OH)-R$ type of alcohols give iodoform test.
- $H_3C-CH(OH)-R + I_2 \xrightarrow[\text{Iodoform test}]{NaOH} CHI_3 + RCOONa$
  Iodoform (Yellow ppt.)

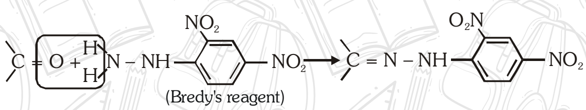
PHENOL

Phenol + ferric chloride (neutral) ⟶ Violet colouration

6  $-OH + FeCl_3 \longrightarrow 3H^+ + [Fe(OC_6H_5)_6]^{3-} + 3HCl$
Violet colouration

CARBONYL GROUP

- Carbonyl compound + 2, 4-DNP (Bredy's reagent) ⟶ Yellow/orange crystal



- All aldehydes and only aliphatic methyl ketones + $NaHSO_3$ → White crystalline bisulphite (Water soluble).

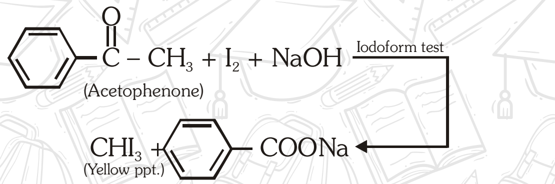
$R(H)C=O + NaHSO_3 \rightleftharpoons R-C(OH)(H)-SO_3^-Na^+$
Aldehyde

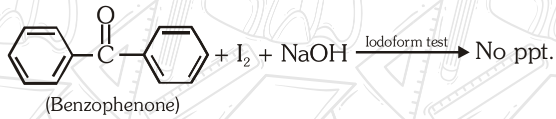
$R(H_3C)C=O + NaHSO_3 \rightleftharpoons R-C(OH)(CH_3)-SO_3^-Na^+$
Methyl ketone

Ethanal and methanal (Iodoform test)

- $CH_3CHO + I_2 + NaOH \xrightarrow{\text{Iodoform test}} CHI_3 + HCOONa$
  Ethanal → Iodoform (Yellow ppt.)
- $HCHO + I_2 + NaOH \xrightarrow{\text{Iodoform test}}$ No yellow ppt.
  Methanal

Acetophenone and benzophenone (Iodoform test)

- 

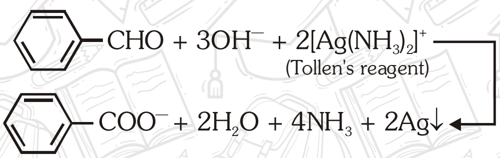
- 

Benzoic acid and ethylbenzoate

- $C_6H_5COOH + NaHCO_3 \rightarrow C_6H_5COONa + CO_2\uparrow + H_2O$
  effervescence
- Ethyl benzoate + Sodium bicarbonate
  $\rightarrow$ No effervescence

Benzaldehyde and acetophenone (Tollen's test)

- Benzaldehyde + Tollen's reagent $\rightarrow$ Silver mirror

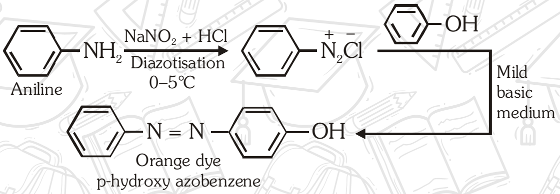


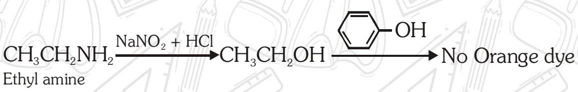
- Acetophenone + Tollen's reagent $\rightarrow$ No silver mirror

Methyl amine and dimethyl amine (Isocyanide test)

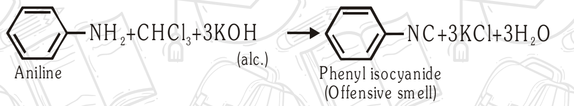
- $CH_3NH_2 + CHCl_3 + 3KOH\,(alc.) \rightarrow CH_3NC + 3KCl + 3H_2O$
  Methyl amine → Methyl isocyanide (Offensive smell)
- $H_3C{-}NH(CH_3) + CHCl_3 + 3KOH(alc.) \rightarrow$ No offensive smell
  Di-methyl amine

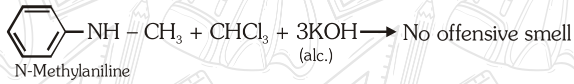
Aniline and ethyl amine (Diazotisation)

- 

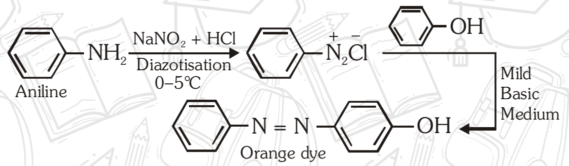
- 

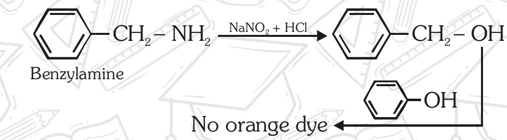
Aniline and N-methylaniline (Isocyanide test)

- 

- 

Aniline and Benzylamine (Diazotisation + phenol)

- 

- 

Glucose and fructose

- Glucose + Br_2 (brown) + $H_2O \rightarrow$ Gluconic acid + 2HBr (colorless)
- Fructose + Br_2 (brown) + $H_2O \rightarrow$ No change in color

Glucose and sucrose

- Glucose + Tollen's reagent $\longrightarrow$ Silver mirror
- Sucrose + Tollen's reagent $\longrightarrow$ No silver mirror

Glucose and starch

- Glucose + Fehling's solution $\longrightarrow$ Red ppt.
- Starch + Fehling's solution $\longrightarrow$ No red ppt.

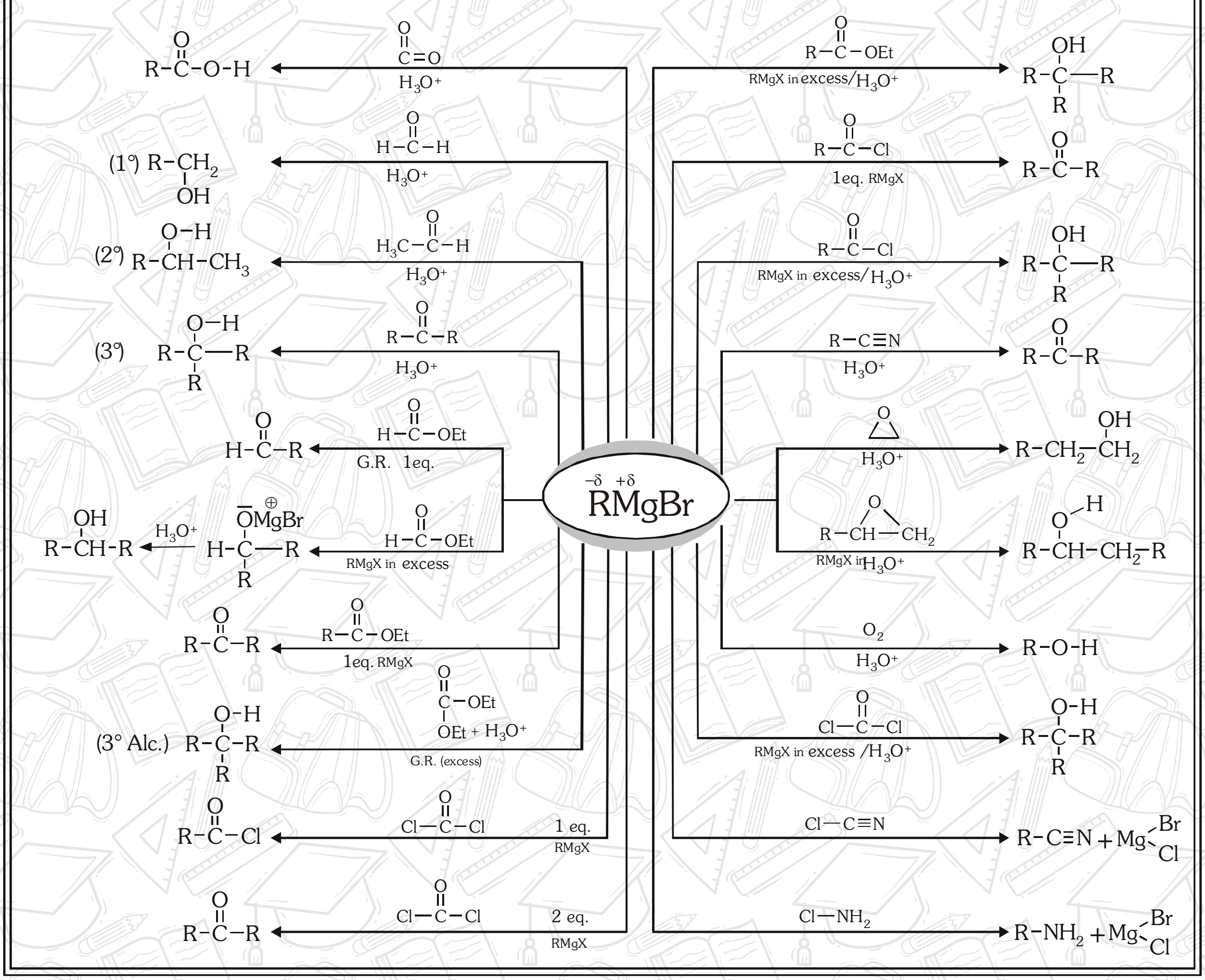
OR

- Glucose + I_2 solution $\longrightarrow$ No blue colour
- Starch + I_2 solution $\longrightarrow$ Blue colour

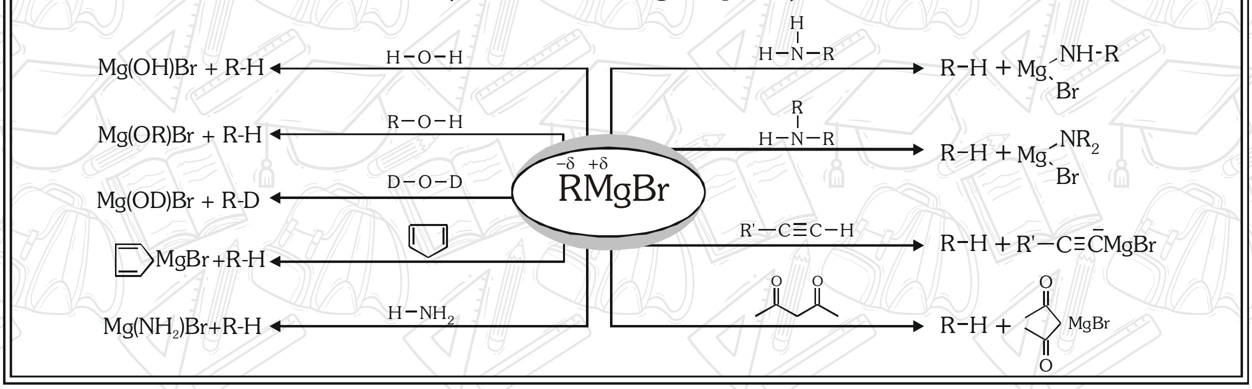
GRIGNARD REAGENT

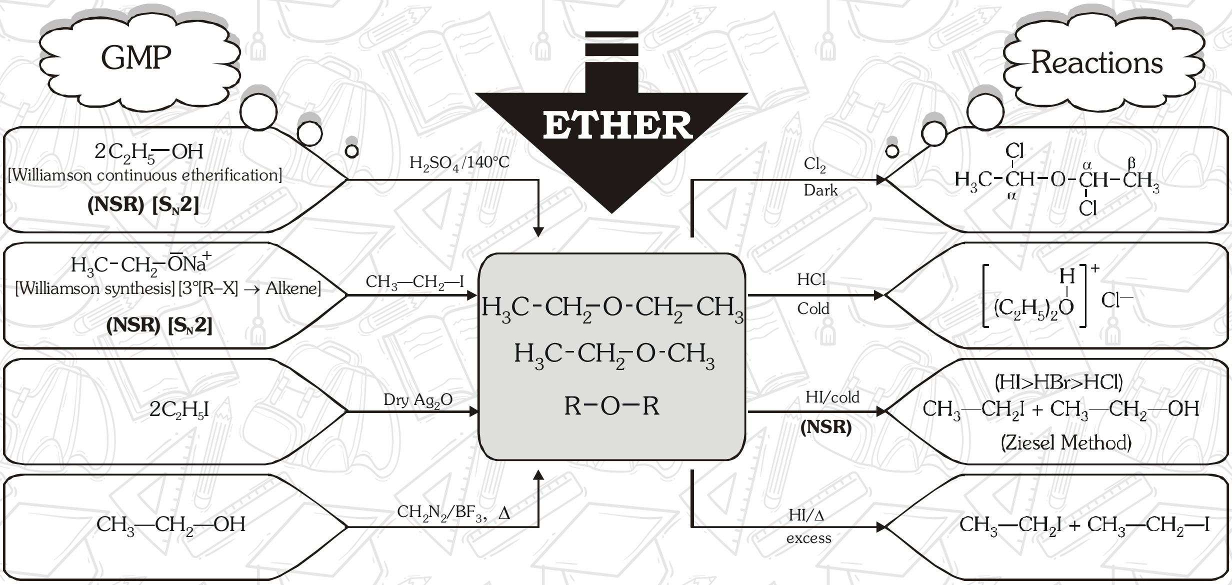
REACTION

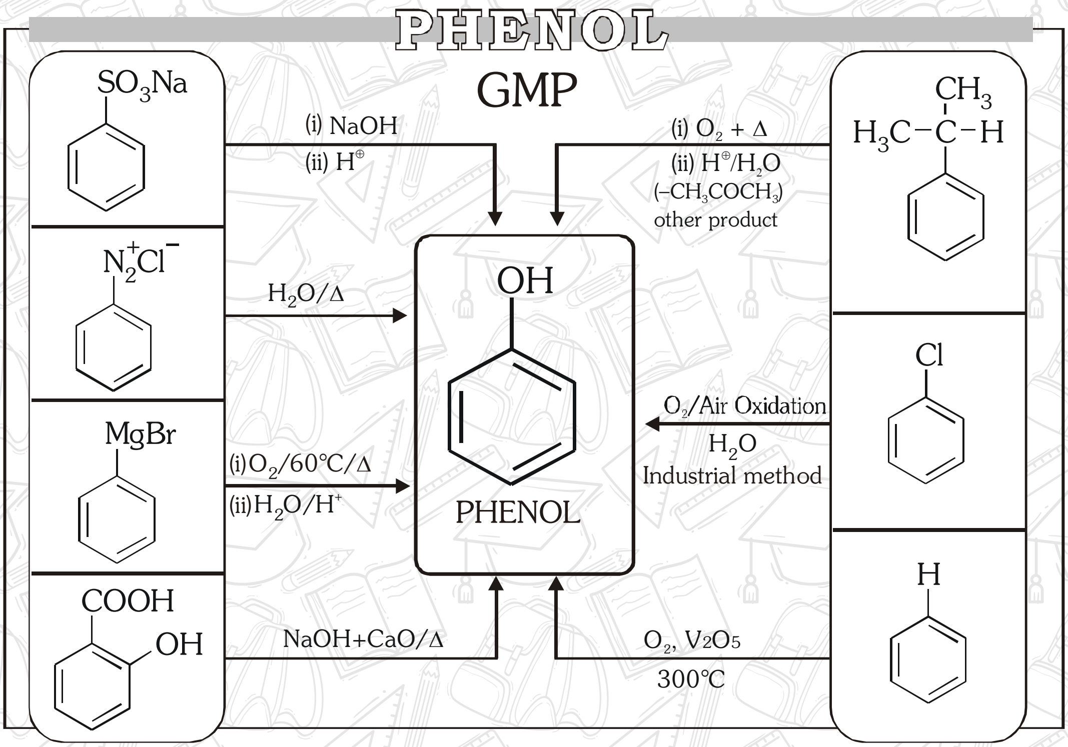
GRIGNARD REAGENT as Nucleophile

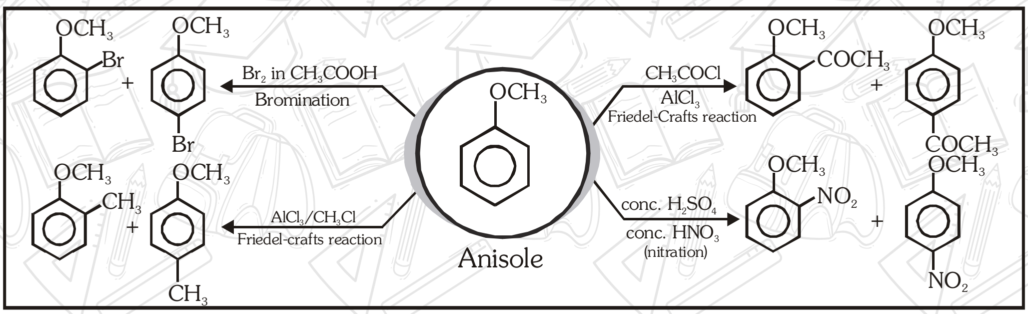


GRIGNARD REAGENT as BASE
(Active H-containing compound)




ETHER
GMP
Reactions
2C2H5—OH
[Williamson continuous etherification]
(NSR) [SN2]
H2SO4 /140°C
H3C-CH2-ŌNa+
[Williamson synthesis] [3°[R–X] → Alkene]
(NSR) [SN2]
CH3—CH2—I
2C2H5I
Dry Ag2O
CH3—CH2—OH
CH2N2/BF3, Δ
H3C-CH2-O-CH2-CH3
H3C-CH2-O-CH3
R–O–R
Cl2
Dark
H3C-CH-O-CH-CH3
Cl
Cl
HCl
Cold
[(C2H5)2O-H]+ Cl–
HI/cold
(NSR)
(HI>HBr>HCl)
CH3—CH2I + CH3—CH2—OH
(Ziesel Method)
HI/Δ
excess
CH3—CH2I + CH3—CH2—I


PHENOL
GMP
SO3Na
(i) NaOH
(ii) H⊕
N2+Cl–
H2O/Δ
MgBr
(i)O2/60°C/Δ
(ii)H2O/H+
COOH
OH
NaOH+CaO/Δ
CH3
H3C–C–H
(i) O2 + Δ
(ii) H⊕/H2O
(–CH3COCH3)
other product
Cl
O2/Air Oxidation
H2O
Industrial method
H
O2, V2O5
300°C
OH
PHENOL


OCH3
Anisole
Br2 in CH3COOH
Bromination
OCH3
Br
+
OCH3
Br
AlCl3/CH3Cl
Friedel-crafts reaction
OCH3
CH3
+
OCH3
CH3
CH3COCl
AlCl3
Friedel-Crafts reaction
OCH3
COCH3
+
OCH3
COCH3
conc. H2SO4
conc. HNO3
(nitration)
OCH3
NO2
+
OCH3
NO2

Comparision of S_N1 and S_N2

	REACTIONS	S_N1	S_N2
A	Kinetics	1st order	2nd order
B	Rate	k[RX]	k[RX][Nu:$^\ominus$]
C	Stereochemistry	Racemisation	Inversion
D	Substrate (reactivity)	3°> 2°>1°>MeX	MeX >1°>2°>3°
E	Nucleophile	Rate Independent	Needs Strong Nu
F	Solvent	Good in protic	Faster in aprotic
G	Leaving Group	Needs Good LG	Needs Good LG
H	Rearrangement	Possible	Not Possible

Comparision of E_1 and E_2

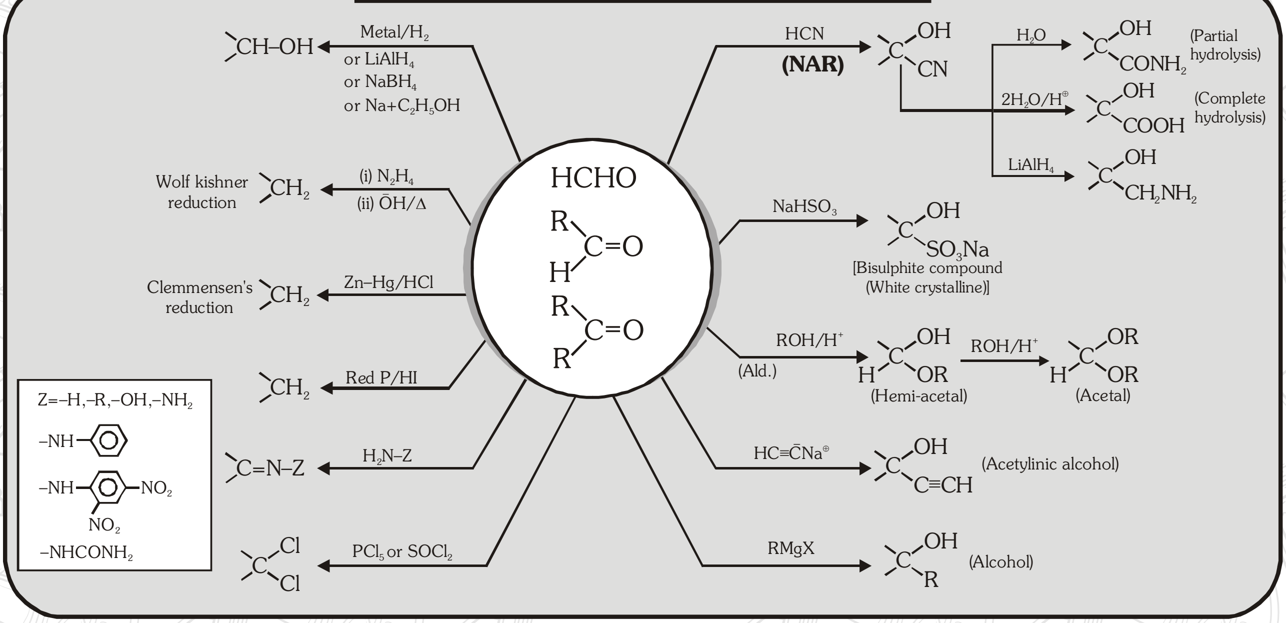
	REACTIONS	E1	E2
A	Kinetics	1st order	2nd order
B	Rate	k[RX]	k[RX][B:$^-$]
C	Stereochemistry	No special geometry	Anti-periplanar
D	Substrate	3° > 2°>>>1°	3° >2° >1°
E	Base Strength	Rate Independent	Needs Strong bases
F	Solvent	Good ionizing	Polarity not import
G	Leaving Group	Needs Good LG	Needs Good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

Summary of S_N1, S_N2, E_1 and E_2 Reactions

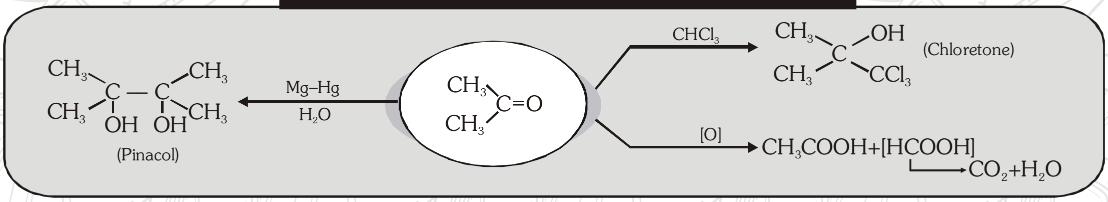
RX	Mechanism	$\overset{\ominus}{Nu}$ / $\overset{\ominus}{B}$	Solvent	Temp.
1°	S_N2	Better Nu$^\ominus$ Aq. KOH, OR$^\ominus$	Polar aprotic	Low
	E2	Strong & bulky base Alc. KOH, $(CH_3)_3CO^\ominus$		High
2°	S_N2	Aq. KOH	Polar aprotic	Low
	E2	OR$^\ominus$, $(CH_3)_3CO^\ominus$		High
	(S_N1)	Solvent	Polar protic	(Low)
	(E1)	Solvent		(High)
3°	S_N1	Solvent	Protic	Low
	E1	Solvent	Protic	High
	E2	Nu$^\ominus$/Base	—	High

	Primary (1°)	Secondary (2°)	Tertiary (3°)
Strong nucleophile	S_N2 >>E2	S_N2 + E_2 (if weak base, S_N2 favored)	E2
Weak nucleophile weak base	Mostly S_N2	Mostly S_N2/S_N1	Mostly S_N1 at low T mostly E1 at high T
Weak nucleophile strong base	Mostly E2	Mostly E2	E2

Reaction of Aldehyde & Ketone



Reaction of only Ketone



Aldol Reaction (Aldehyde or ketone with αH)

(i) $2CH_3CHO \underset{}{\overset{\text{dil. NaOH}}{\rightleftharpoons}} CH_3-\underset{OH}{\underset{|}{CH}}-CH_2-CHO$ (Aldol) $\xrightarrow[-H_2O]{\Delta} CH_3-CH=CH-CHO$ (Aldol condensation product)

(ii) $2CH_3COCH_3 \overset{Ba(OH)_2}{\rightleftharpoons} CH_3-\overset{CH_3}{\underset{OH}{C}}-CH_2COCH_3$ (Ketol) $\xrightarrow[-H_2O]{\Delta} CH_3-\overset{CH_3}{C}=CH-COCH_3$ (Aldol condensation product)

Cannizzaro reaction (Aldehyde with no α H)

$$2HCHO \xrightarrow[\Delta]{\text{conc. NaOH}} CH_3OH + HCOO^-Na^+$$

TESTS

Tollen's test :-

$$RCHO + 2[Ag(NH_3)_2]^+ + 3\ ^-OH \longrightarrow RCOO^- + 2Ag + 2H_2O + 4NH_3$$

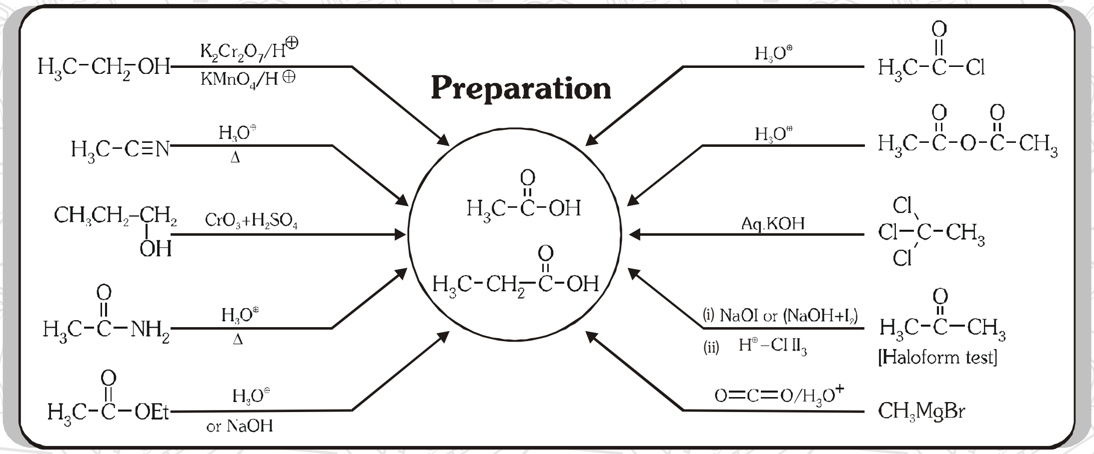
(Given by Aliphatic and aromatic aldehyde)

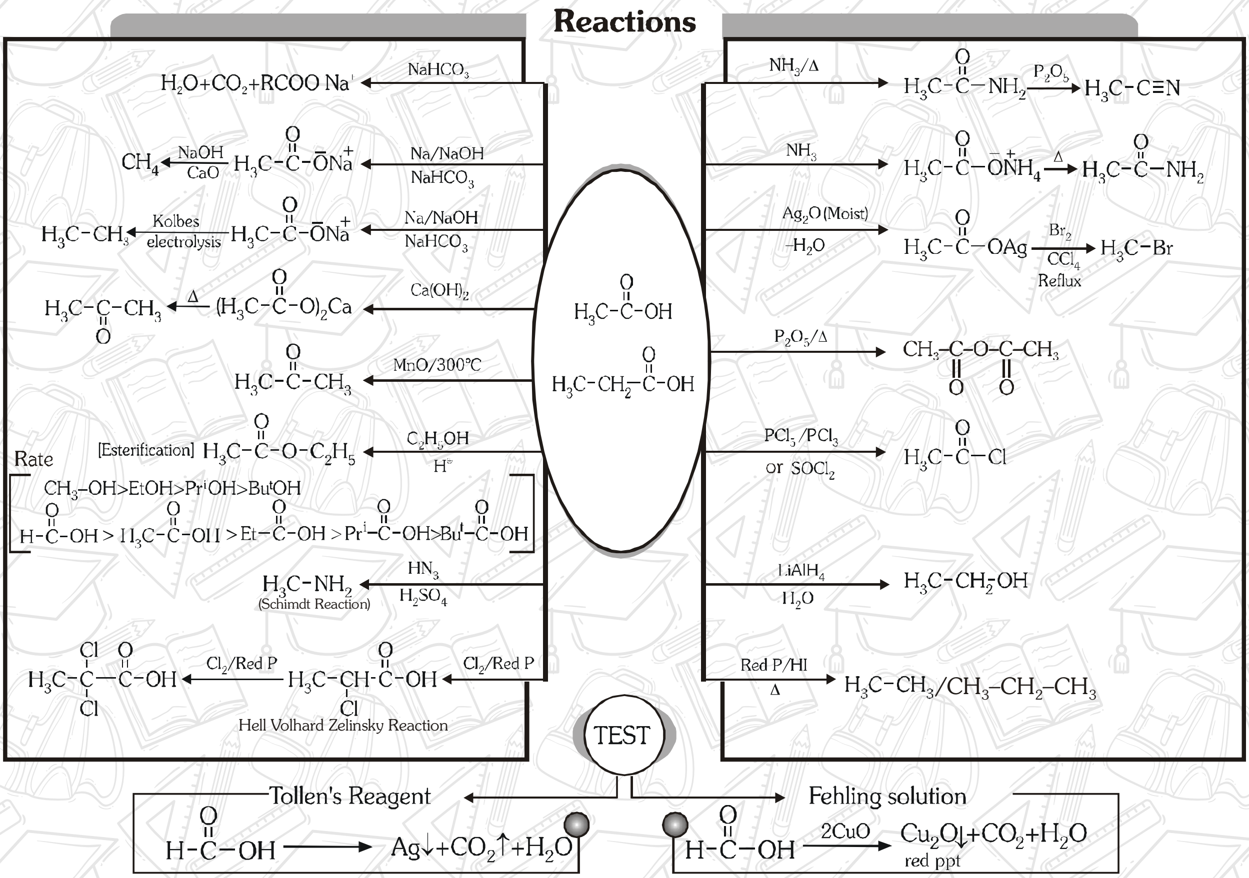
Fehling's test

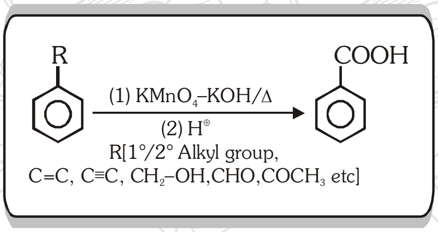
$$RCHO + 2Cu^{+2} + 5\ ^-OH \longrightarrow RCOO^- + Cu_2O + 3H_2O$$

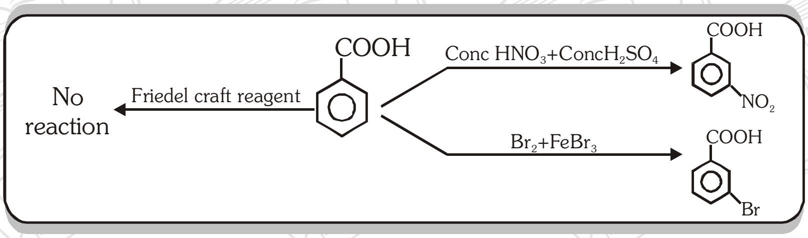
(Given by Aliphatic aldehyde) (Red-Brown ppt.)

CARBOXYLIC ACID



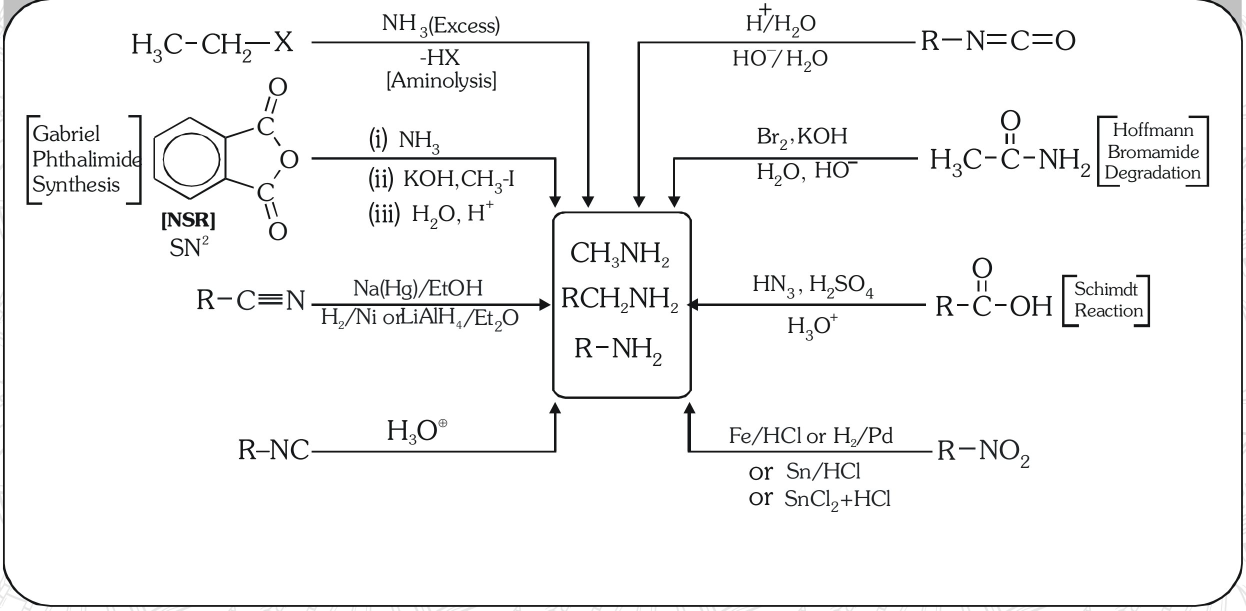




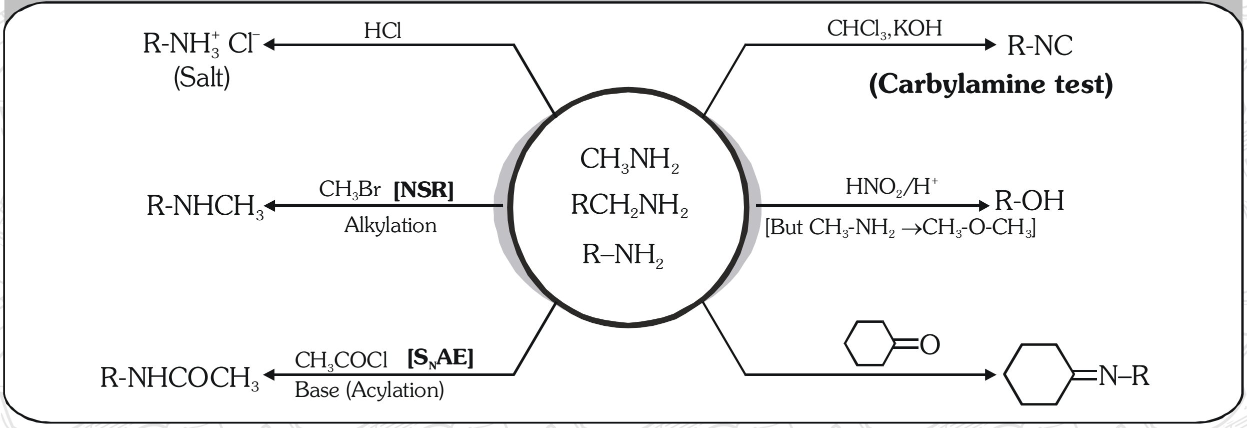


AMINES

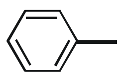
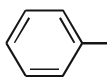
PREPARATION



REACTION

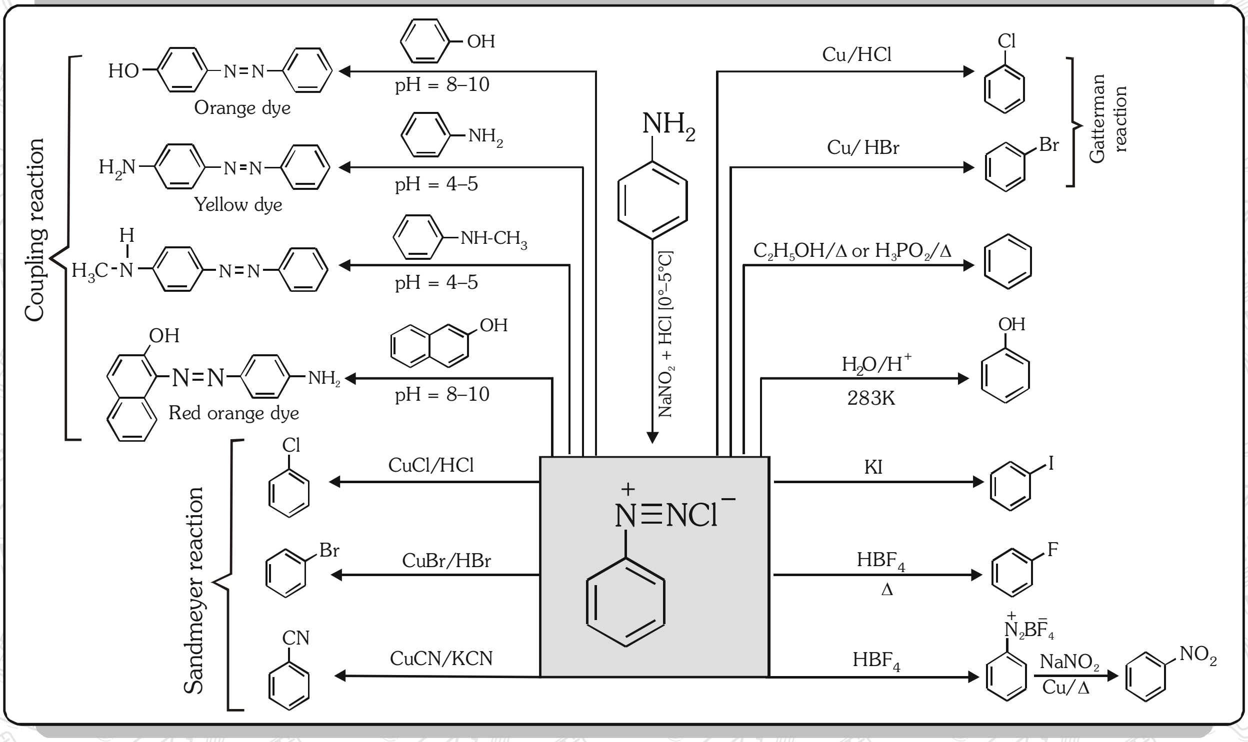


TEST

Reagent	R–N̈H_2(1°)	R_2N̈H(2°)	R_3N̈(3°)	 N̈H_2
Ph–SO_2Cl (Hinsberg reagent)	R−N(H)−SO_2−Ph soluble; ↓NaOH; [R−N̄−SO_2−Ph]Na^+ soluble	R_2N–SO_2–Ph; ↓NaOH; Insoluble	No reaction	 −NH−SO_2−Ph Soluble in base
S=C=S (CS_2) Δ/$HgCl_2$ Mustard oil test	R−NH−C(=S)−SH; $HgCl_2$ ↓ Δ; R–N=C=S+HgS	R_2N−C(=S)−SH; $HgCl_2$ ↓ Δ; No reaction	No reaction	Ph—NH / Ph—NH >C=S

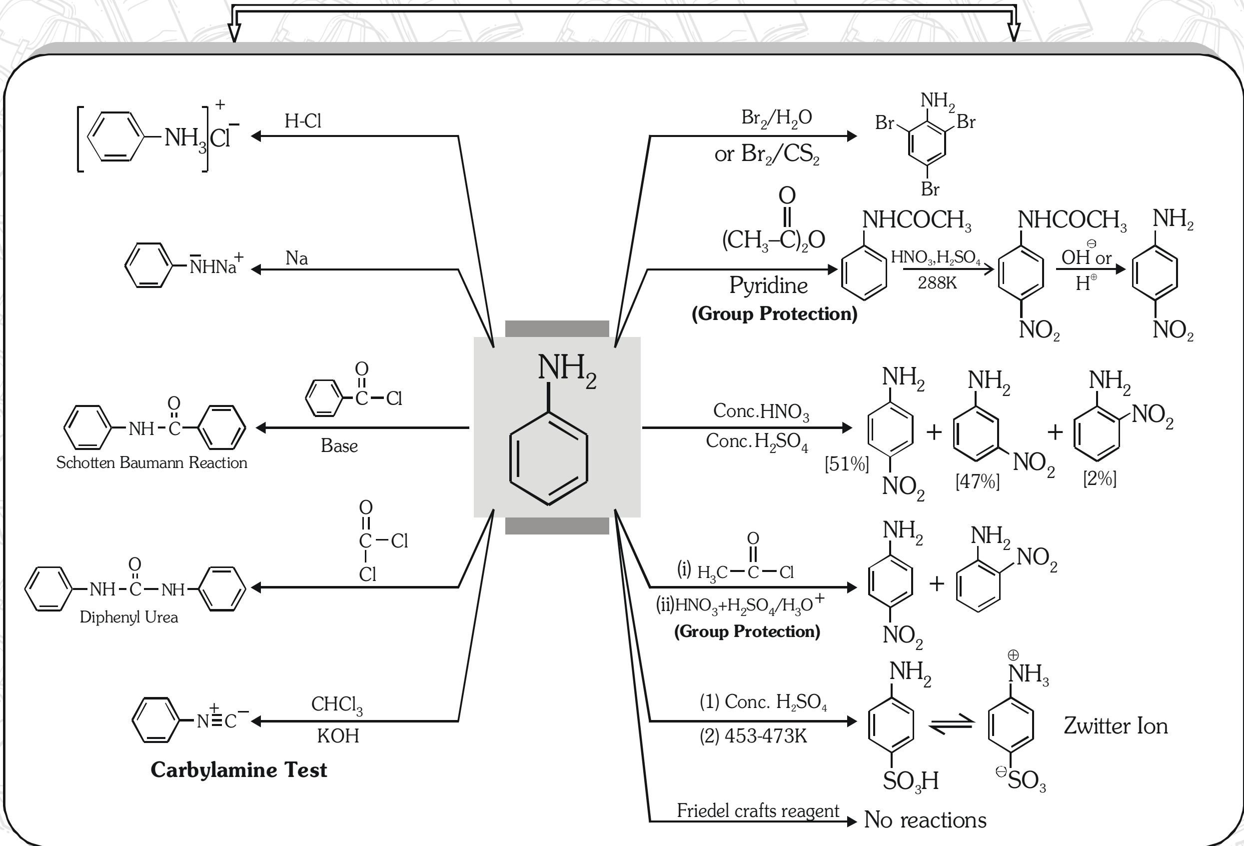
BENZENE DIAZONIUM CHLORIDE

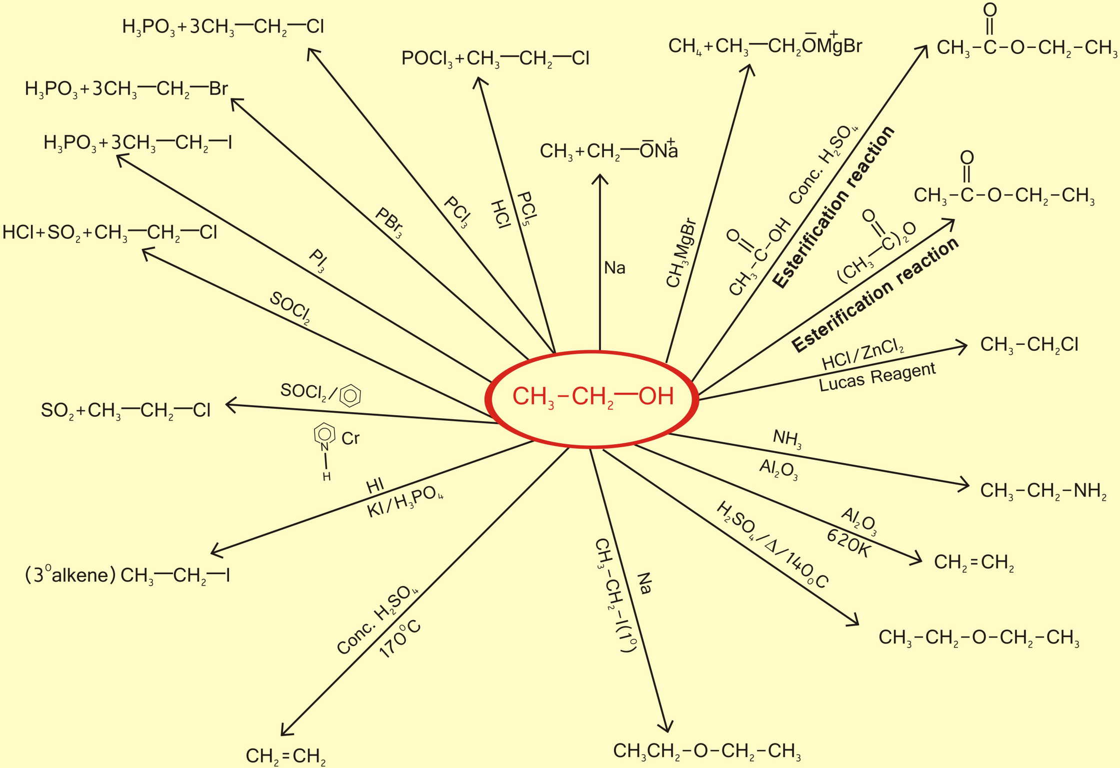
REACTION



ANILINE

REACTION

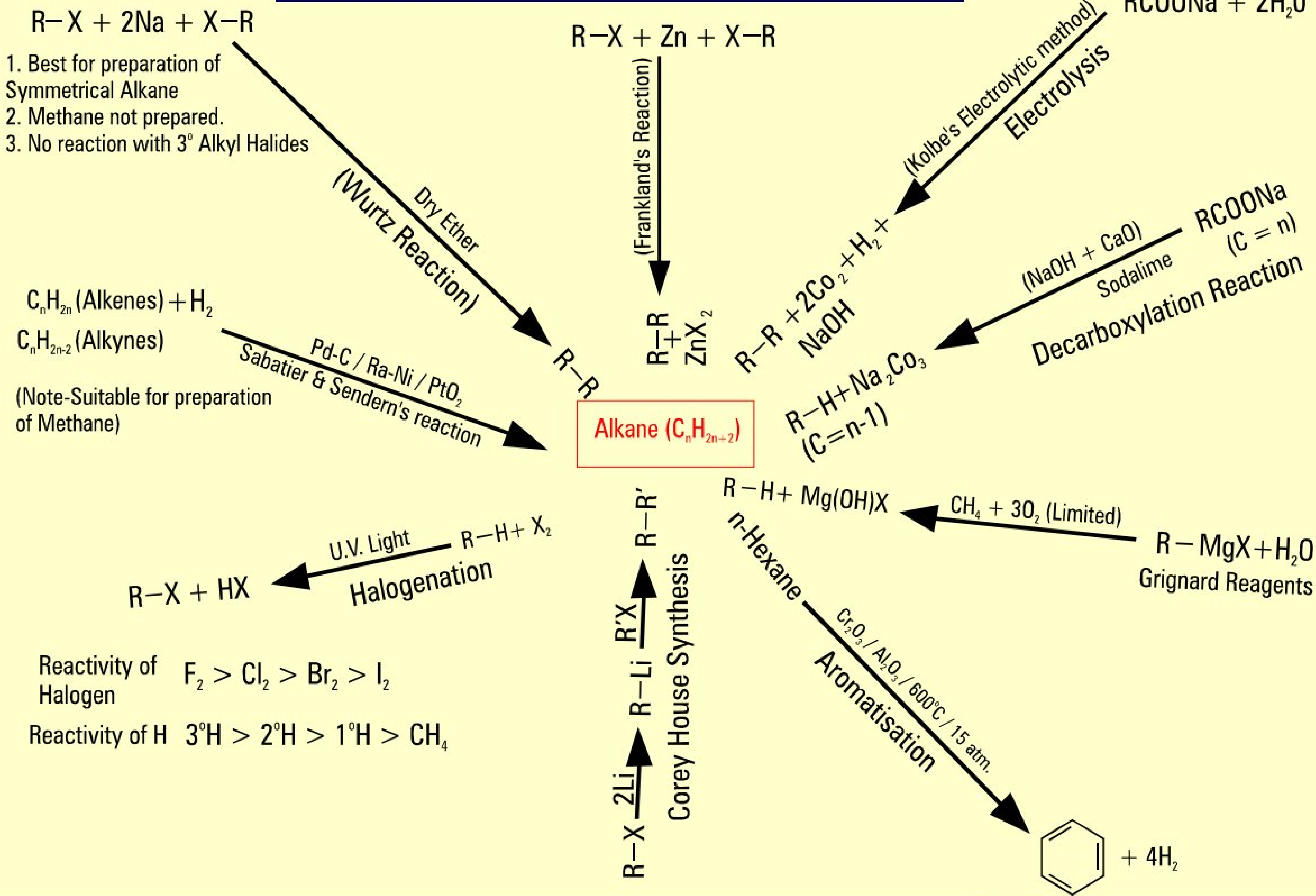



CH3–CH2—OH
H3PO3 + 3CH3—CH2—Cl
PCl3
POCl3 + CH3—CH2—Cl
HCl
PCl5
CH3 + CH2—O⁻Na⁺
Na
CH4 + CH3—CH2O⁻MgBr⁺
CH3MgBr
CH3–C(=O)–O–CH2–CH3
Conc. H2SO4
CH3–C(=O)–OH
Esterification reaction
CH3–C(=O)–O–CH2–CH3
(CH3–C(=O))2O
Esterification reaction
CH3–CH2Cl
HCl / ZnCl2
Lucas Reagent
CH3–CH2–NH2
NH3
Al2O3
CH2=CH2
Al2O3
620K
CH3–CH2–O–CH2–CH3
H2SO4 / Δ / 140°C
CH3CH2–O–CH2–CH3
Na
CH3–CH2–I(1°)
CH2=CH2
Conc. H2SO4
170°C
(3° alkene) CH3—CH2—I
HI
KI / H3PO4
SO2 + CH3—CH2—Cl
SOCl2 /
Cr
N
H
HCl + SO2 + CH3—CH2—Cl
SOCl2
H3PO3 + 3CH3—CH2—I
PI3
H3PO3 + 3CH3—CH2—Br
PBr3

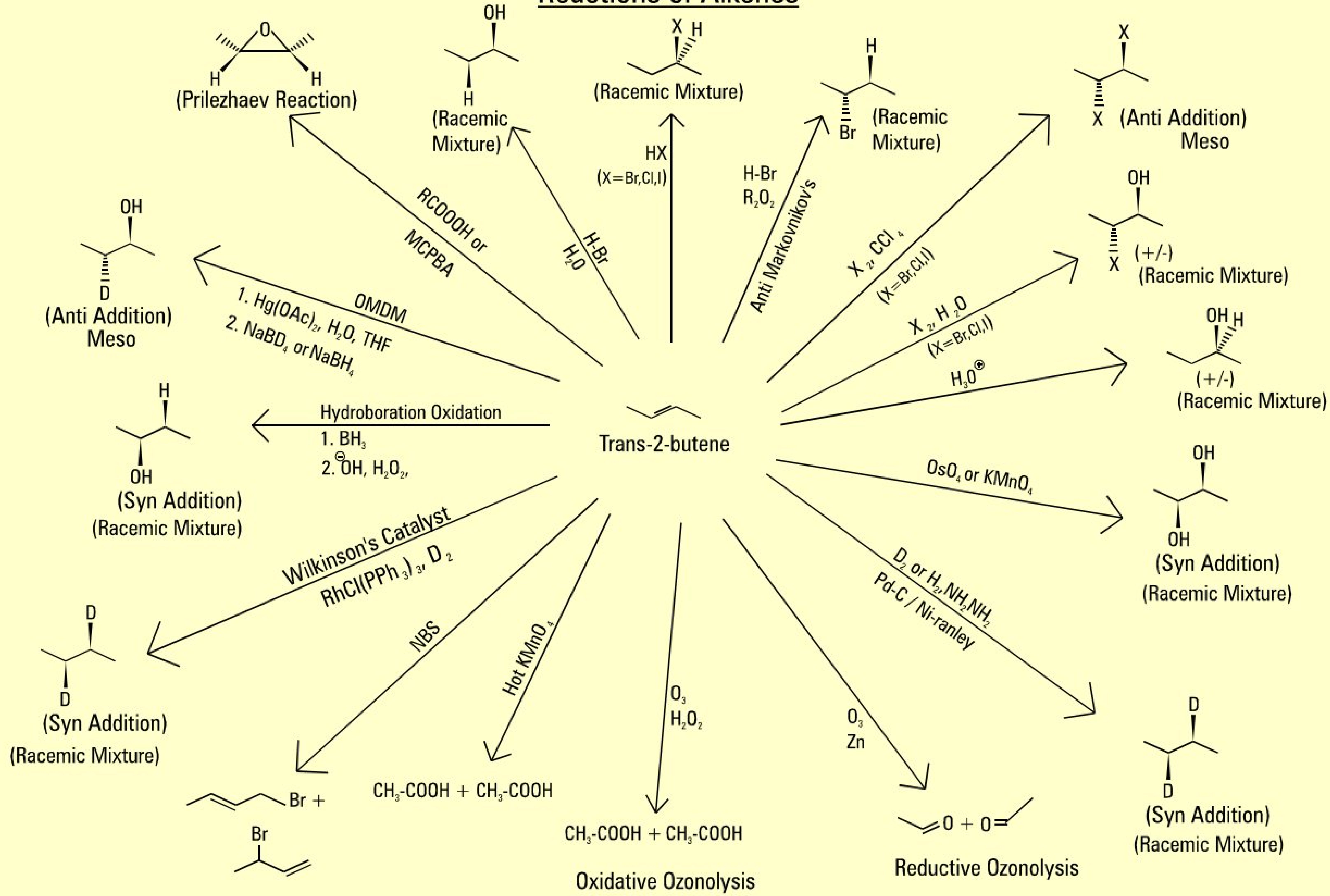
Reagent	$H_3C-CH_2-CH_2-CH_2-OH$ 1° Alcohol	$H_3C-CH_2-CH(OH)-CH_3$ 2° Alcohol	$H_3C-C(CH_3)_2-OH$ 3° Alcohol
PCC/CH_2Cl_2 H_2CrO_4/Acetone (Jones Reagent)	$H_3C-CH_2-CH_2-C(=O)-H$	$H_3C-CH_2-C(=O)-CH_3$	No Reaction
$K_2Cr_2O_7/H^+$ or $KMnO_4/H^+$	$H_3C-CH_2-CH_2-C(=O)-OH$	$H_3C-CH_2-C(=O)-CH_3$	No Reaction
Cu/500°C	$H_3C-CH_2-CH_2-C(=O)-H$	$CH_3-CH_2-C(=O)-CH_3$	$H_3C-C(CH_3)=CH_2$
$\xrightarrow[\text{Acetone or Cyclohexanone}]{Al(OBu^1)_3}$	$H_3C-CH_2-CH_2-C(=O)-H$	$H_3C-CH_2-C(=O)-CH_3$	
Lucas Reagent $HCl/ZnCl_2$	Cloudiness appear uponheating after 30 mions at normal temp. no reaction	within five mins	Immediately
Victor Mayer's Test			
P/I_2	$CH_3-CH_2-CH_2-CH_2-I$	$H_3C-CH_2-CH(CH_3)-I$	$H_3C-C(CH_3)_2-I$
$AgNO_3$	$CH_3-CH_2-CH_2-NO_2$	$H_3C-CH_2-CH(CH_3)-NO_2$	$(CH_3)_3-NO_2$
HNO_2 NaOH	$H_3C-CH_2-C(=N-OH)-NO_2$	$H_3C-C(CH_3)(N=O)H_2-CH-NO_2$	No Reaction ↓

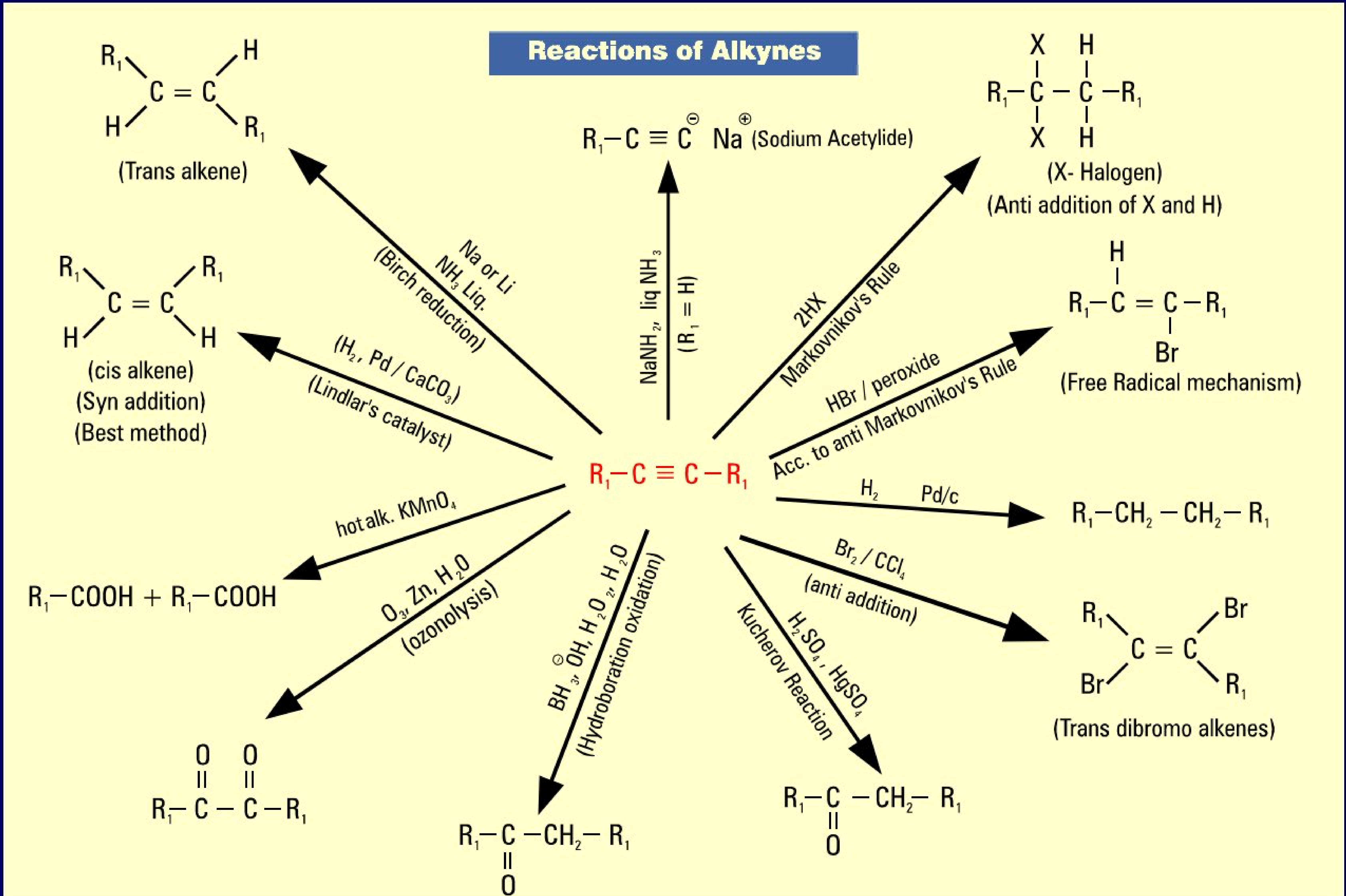
Cl
Benzoyl
Chloride
Benzene
H2
Pd - BaSO4
"Rosenmund
Reduction"
Co, HCl
Anhy. AlCl3 / CuCl
"Gatterman Koch
Reaction"
CHO
CN
CH = NH
SnCl2
HCl
H3O⊕
H2O
373K
CHCl2
"Stephen Reduction"
CrO2Cl2/CS2
H3O⊕
Cl2/hυ
CH3
Toluene
"Etard Reaction"
"Commercial method
of Preparation"

Preparation & Chemical Reactions of Alkanes

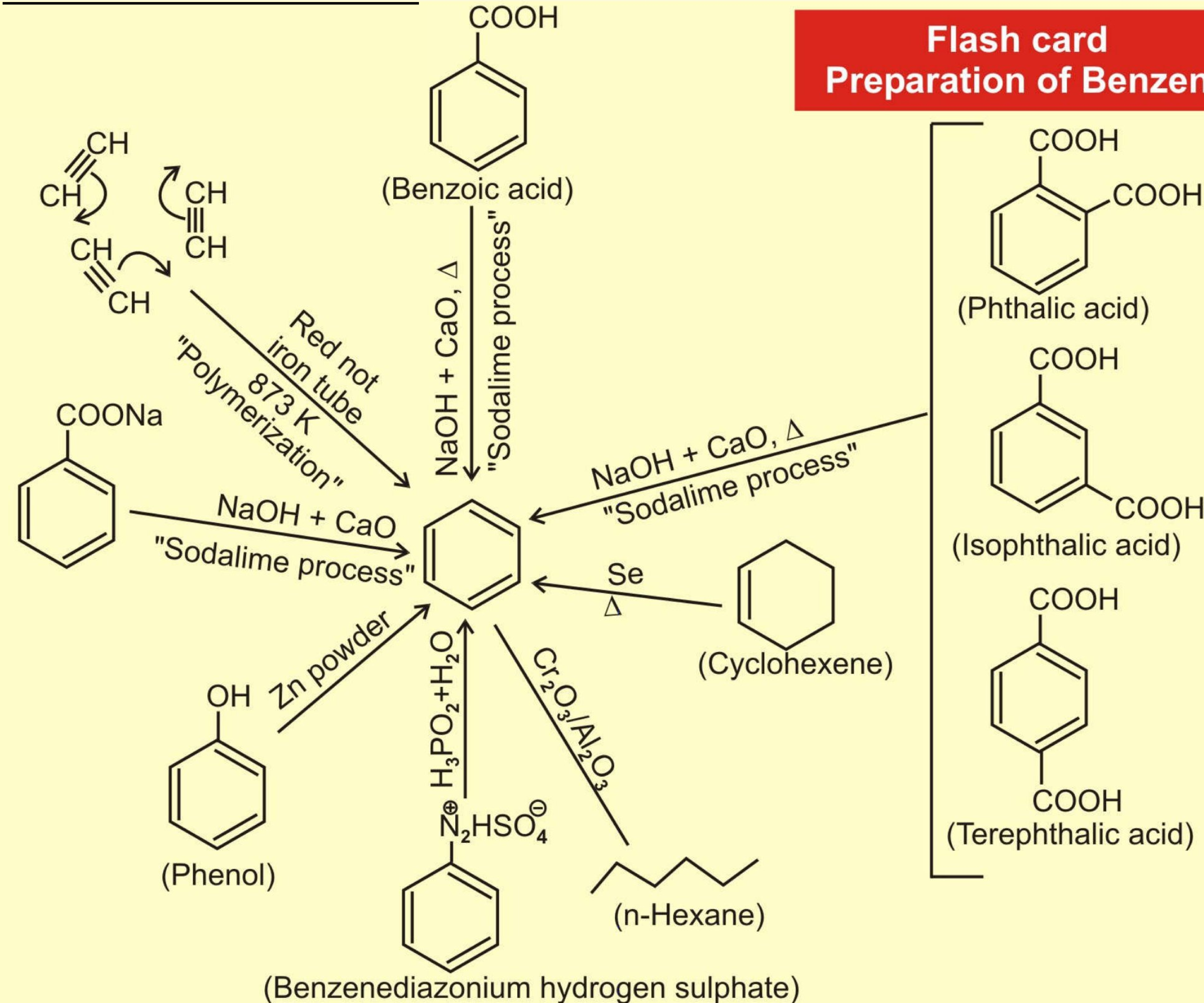


Reactions of Alkenes




Reactions of Alkynes
R1–C ≡ C–R1
R1–C ≡ C⊖ Na⊕ (Sodium Acetylide)
NaNH2, liq NH3
(R1 = H)
Na or Li
NH3 Liq.
(Birch reduction)
(Trans alkene)
(H2, Pd / CaCO3)
(Lindlar's catalyst)
(cis alkene)
(Syn addition)
(Best method)
2HX
Markovnikov's Rule
(X- Halogen)
(Anti addition of X and H)
HBr / peroxide
Acc. to anti Markovnikov's Rule
(Free Radical mechanism)
H2 Pd/c
R1–CH2 – CH2– R1
Br2 / CCl4
(anti addition)
(Trans dibromo alkenes)
H2SO4, HgSO4
Kucherov Reaction
BH3, ⊖OH, H2O2, H2O
(Hydroboration oxidation)
O3, Zn, H2O
(ozonolysis)
hot alk. KMnO4
R1–COOH + R1–COOH

Flash card
Preparation of Benzene



Flash card
Reactions of Benzene

Electrophilic Substitution Reaction of Benzene

NOTE :

Rate of iodination & sulphonation is : $C_6H_6 > C_6D_6 > C_6T_6$