(weaker) (stronger)
$NaBH_4$ or $LiAlH_4$ — Aldehydes, keytone → Alcohol
cattack (-"-)

isocyanides, nitro, cyanides, into amines
$-NH-CH_3$ $-NH_2$ $-NH-CH_3$

H_2/Ni or H_2/Pd (Reduction) — Aldehyde, keytone, cyanide
ROH 2°-OH $-CH_2NH_2$

RMgX (Grignard) / H_3O^+ — Aldehyde → 2° ROH, keytone → 3°-ROH } alcohol

$O_2/H^{\oplus}$ — Cumene → phenol

Na — Alcohol → Alcoxide (sodium); phenol → phenoxide (sodium)

$CH_3-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-CH_3$ or $CH_3-\overset{O}{\overset{\|}{C}}-Cl$
(i) — O-acylation → phenol
(ii) — N-acylation → Aniline
(iii) — N-acylation → Amine

(con.) H_2SO_4 / 443K (hot) — 1° Alcohols → Alkene
(con.) H_2SO_4 / 410K (cold) — Alcohols → ethers
(85%) H_3PO_4 / 440K (hot) $\Delta\uparrow$ — 2° Alcohol → Alkene
(20%) H_3PO_4 / 358K (cold) Δ — 3° Alcohol → Alkene ($-H_2$
Alcoholic KOH (E_2 elimination) — Alkylhalide → Alkene
CrO_3 / $KMnO_4$ or $K_2Cr_2O_7$ ($H^{\oplus}$) (i) — 1° Alcohol → carboxyla
(ii) — 2° Alcohol → keytone

Cu / 573K (oxidizer)
(i) — 1° Alcohol → Aldehyde
(ii) — 2° Alcohol → keytone
(iii) — 3° Alcohol → Alkene

Dilute HNO_3 — Mononitration of phen

$CO/HCl/AlCl_3$ (Anhy.) (Gattermann's) Benzene → Benzaldehyde

$(CH_3)_2Cd$ (Quacher's) Acid chloride → keytone

$RMgX/H_3O^{\oplus}$ Cyanides → keytones

HCN Carbonyl → cyanohydrin.

$NaHSO_3$ (Test) Addition of $-\underset{OH}{\underset{|}{C}}-CN$ to Aldehyde / keytone.

H_2NOH carbonyl → oxime

H_2N-NH_2 carbonyl → hydrazone

$\downarrow OH^{\ominus}$

Alkene

$H_2N-NH-Ph$ carbonyl → phenyl hydrazone

2,4 DNP (Braddy's reagent) carbonyl → 2,4 dinitrophenyl hydrazone (orange red)

Test

$H_2N-NH-\overset{O}{\overset{\|}{C}}-CH_3$ carbonyl → semicarbazone

$R-OH/HCl$ (i) — Aldehyde → hemiacetal

(ii) — keytone → acetal

$HO-CH_2-CH_2-OH/HCl$

(ethylene glycol)

$Zn-Hg/HCl$ (clemenson) $-\overset{O}{\overset{\|}{C}}-CH_2-$ carbonyl → Alkane

(Zinc Amalgum) (Base-sensitive) (Lewis)

H_2N-NH_2/KOH (weak) (Wolf kishner) (acid sensitive) (Lewis)

$(KMnO_4/OH^{\ominus}/K_2Cr_2O_7$ carbonyl → Alkane

$+ H_2SO_4/HNO_3)$ Keytone → mix of carbo

(oxidising mix) 3° Alcohols oxalic acids.

$[Ag(NH_3)_2]OH$ (Tollens test) $Ag\downarrow$

$Cu(OH)_2$ (Fehling's test) $CuO \rightarrow Cu_2O$ (Re

c.) HNO_3 (dil for mono halogenated) (Tri) nitration of phenol
Br_2/H_2O (Tri) bromination (white ppt) of phenol

Br_2/CS_2 (i) ⟶ Mono bromination of phenol
(ii) ⟶ mono bromination of aniline

$NaOH/CO_2$ Phenol ⟶ salicylic acid
$CHCl_3/NaOH$ (Reimer Tiemann) Phenol ⟶ o-salicylaldehyde

Zn dust Phenol ⟶ Benzene
$Na_2Cr_2O_7/H_2SO_4/air$ Phenol ⟶ Benzoquinone

Zn/Cr_2O_3 (200-300 atm) (573/673 K) $COH \rightarrow CH_3OH$
Invertase Sucrose ⟶ Glucose + fructose

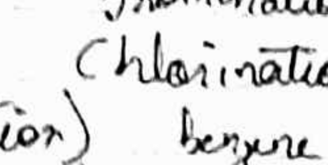
Zymase (i) ⟶ Glucose $\xrightarrow{[O]}$ ethanol
(ii) ⟶ fructose $\xrightarrow{[O]}$ ethanol

HI (master) (master reducing agent) (Hydrogen iodide in red phosphorus) (in Red P) $-COOH \rightarrow$ Alkane, ether ⟶ alcohol ⟶ Alkyl iodide

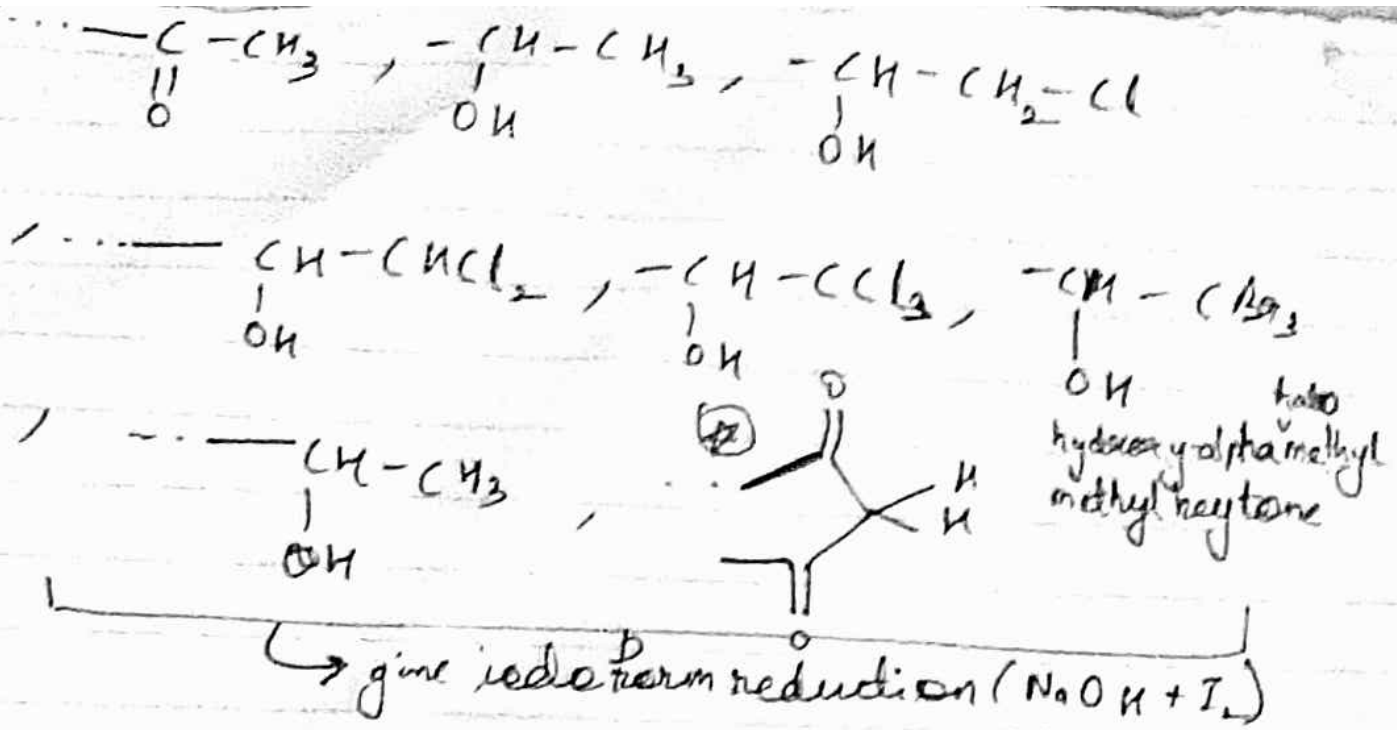
Pyridinium chlorochromate (i) ⟶ 1° Alcohol ⟶ Aldehyde
(ii) ⟶ 2° Alcohol ⟶ ketone

$Pd/BaSO_4/H^{\oplus}$ (Rosenmund) Acid chloride ⟶ Aldehyde
$SnCl_2/HCl/H_3O^{\oplus}$ (Stephen) Cyanides ⟶ Aldehydes
$AlH(i\text{-}Bu)_2/H_2O$ (DiBAL-H) Cyanides ⟶ Aldehydes
CrO_2Cl_2/H_2O (Etard) Toluene ⟶ Aldehyde
$CrO_3/(CH_3CO)_2O$ (similar to Etard) Toluene ⟶ Benzaldehyde
$Cl_2/h\nu$ (side chain rxn) (free radical) chlorination ⟶ Alkyl groups of benzene/alkane

(strong)
HCl / $ZnCl_2$, HBr, HI (Lucas) Alcohol → Alkyl Halide
Cl_2 / Fe or $FeCl_3$ Cl group → Benzene
PCl_3 or PBr_3 or PI_3 (CH_3 for 1°, 2°) Alcohol → Alkyl halide
$SOCl_2$ or PCl_5 (i) Alcohol → Alkyl chloride
(ii) Carboxylic acid → Acid chloride
$NaNO_2$/HCl (0–5°C) (Diazotization) Ph-NH_2 → PhN_2Cl
R-NH_2 → $R^{\oplus}$ → Alkene
→ R-OH
CuCl or CuBr or CuI or KI (Sandmeyers) → PhN_2-Cl → diazonium halide
H_2O (Similar) PhN_2-Cl → Phenol
H_3PO_2 (Similar) PhN_2-Cl → Benzene
HBF_4 or $NaBF_4$ PhN_2-Cl → Ph-F
AgF or Hg_2F_2 or SbF_3 or CoF_2 (Swarts) Alkyl halide → Alkyl fluoride
Na / dry ether (Wurtz) Alkyl halide → Alkane
NaOH (623/443/368)K (Dow's) Chlorobenzene → phenol
Br_2 / $FeBr_3$ Bromination of benzene
Cl_2 / $FeCl_3$ Chlorination of benzene
CH_3Cl/$AlCl_3$ (Friedel Alkylation) benzene → toluene
CH_3-C(=O)-Cl/$AlCl_3$ (Friedel Acylation) Benzene → Acyl Benzene
CH_3-C(=O)-O-CH_2-CH_3/$AlCl_3$ phenol → O-Acylphenol
CH_3-C(=O)-Cl/NaOH/Δ



H_2SO_4 (conc) sulphonation of benzene (-SO_3H)
H_2O/H_2SO_4 (Addition of water) Alkene → alcohol
Aq. KOH (S_N2) Alkyl halide → Alcohol
BH_3 / H_2O_2/$OH^{\ominus}$ (oxymercuration demercuration) Alkene → alcohol
(Anti mar



NaOH or $Ba(OH)_2$ (Aldol) β-hydroxycarbonyl
conc. KOH or NaOH) (Cannizzaro) (α-H) Alcohol + Acid

MnO_4/KOH (i) —— Toluene → Benzoic acid
(Strong oxidizer) (ii) —— Alkylbenzene → Benzoic acid

$H_2O/H^{\oplus}$ (Hydration) $-CN^{\ominus}$ → carboxylic acid
(Acidic medium) Amide → carboxylic acid
ester → carboxylic acid
Acid chloride/Alcohols/Anhydrides
→ carboxylic acid.

NaOH
ester →
(i) —— Saponification of ester
(ii) —— Acid → acid salt

Na_2CO_3 or $NaHCO_3$ (Sulfonic acid test) (Carboxylic acid test)

$NaHCO_3 \xrightarrow{\pi} CO_2\uparrow$; π : R-COOH, R-SO3H