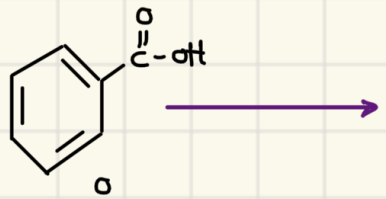
Chapter 10 & Carboxylic Acids

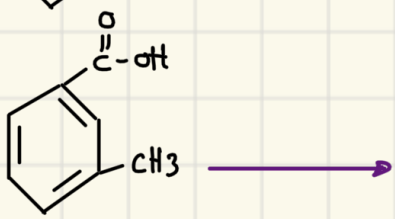
* Has General formula RCOOH

Common names

① $H-\overset{O}{\overset{\|}{C}}-OH$ ⟶ Formic acid (methanoic acid)

② $CH_3-\overset{O}{\overset{\|}{C}}-OH$ ⟶ Acetic acid (Ethanoic acid)

③  ⟶ Benzoic acid

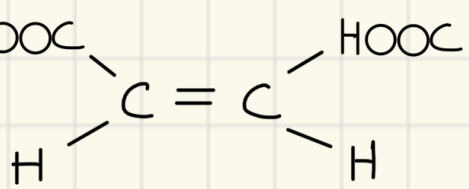
④  ⟶ m- Toluic acid

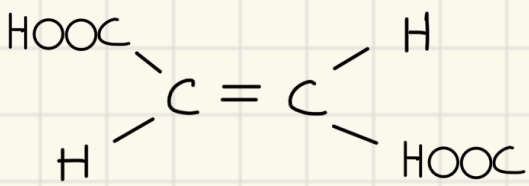
⑤ $Cl_3C-\overset{O}{\overset{\|}{C}}OH$ ⟶ Trichloro acetic acid

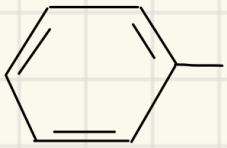
⑥ $HOOC-COOH$ ⟶ oxalic acid

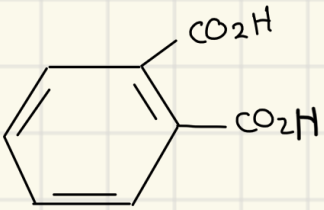
⑦ $HOOC-CH_2-COOH$ ⟶ malonic acid

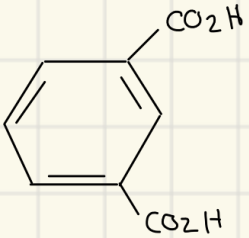
⑧ $HOOC-C\equiv C-COOH$ ⟶ Butynedioic acid

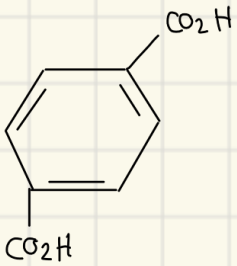
⑨  ⟶ maleic acid

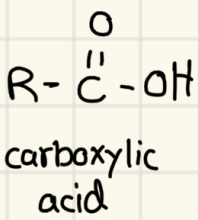
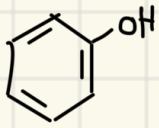
⑩  ⟶ fumaric

(11)  → Benzoyl

(12)  → phthalic acid

(13)  → isophthalic acid

(14)  → terephthalic acid

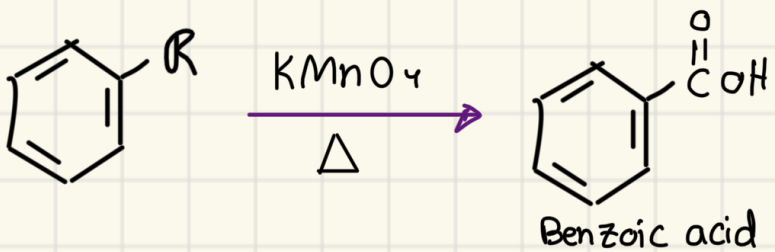
- Boiling point : Acid > Alcohol > Aldehyde
- Acidity :  carboxylic acid >  phenol > ROH Alcohol

Synthesis of carboxylic acid

→ Oxidation of- → 1° Alcohol (RCH_2OH) $\xrightarrow{CrO_3, H^+}$ carboxylic acid

→ Aldehyde $\xrightarrow{CrO_3, H^+}$ carboxylic acid

→ Oxidation of side chain of Benzene



Benzoic acid

regardless length of R

→ Hydrolysis of Nitriles

$R-C\equiv N$ called Nitrile

$\xrightarrow[\Delta]{H_2O, H^+}$ $R-COH + NH_4^+$

$\xrightarrow[\Delta]{H_2O, OH^-}$ $R-CO^-$ carboxylate $\xrightarrow{H^+}$ $RCOH$

→ Grignard reagent

$R-MgX + O=C=O \xrightarrow{H^+} RCOH$

Carboxylic and derivatives

1. $R-\overset{O}{\overset{\|}{C}}-X$ — Acyl halid
2. $R-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-R$ — Acid Anhydride
3. $R-\overset{O}{\overset{\|}{C}}-OR$ — Ester
4. $R-\overset{O}{\overset{\|}{C}}-N\overset{S}{\sim}$ — Amide

* الترتيب مهم

كل مشتقة تصنع ما يوجد أسفلها من المشتقات

for example acyl Halid reactions produce AnHydride , Ester , Amide بالاضافة لل Hydrolysis الذي ينتج carboxylic acid

• Acyl Halides

Synthesis: $R-\overset{O}{\overset{\|}{C}}-OH \xrightarrow{PCl_2 \text{ or } SOCl_2} R-\overset{O}{\overset{\|}{C}}-Cl$

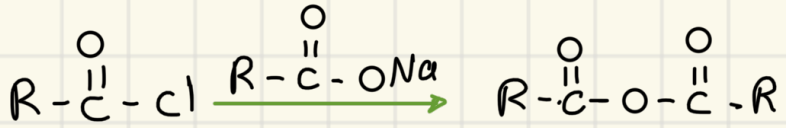
Reactions: $R-\overset{O}{\overset{\|}{C}}-Cl$

- $\xrightarrow{Hydrolysis\ (H_2O)} R-\overset{O}{\overset{\|}{C}}-OH$ (carboxylic acid)
- $R-\overset{O}{\overset{\|}{C}}-O^- \rightarrow R-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-R$ (Acid Anhydride)
- $RO-H \rightarrow R-\overset{O}{\overset{\|}{C}}OR$ (Ester)
- $H-\overset{S}{N}\sim \rightarrow R-\overset{O}{\overset{\|}{C}}-\overset{S}{N}\sim$ (Amide)

- Machanism of reaction called Nucleophilic Acyl Subtitution
- Any Hydrolysis reaction of Any derivative retain us Back to the carboxylic Acid

• Acid AnHydride

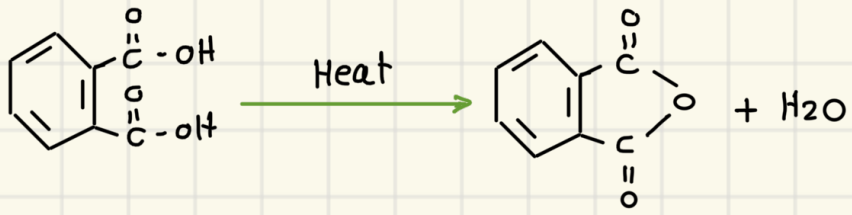
Synthesis



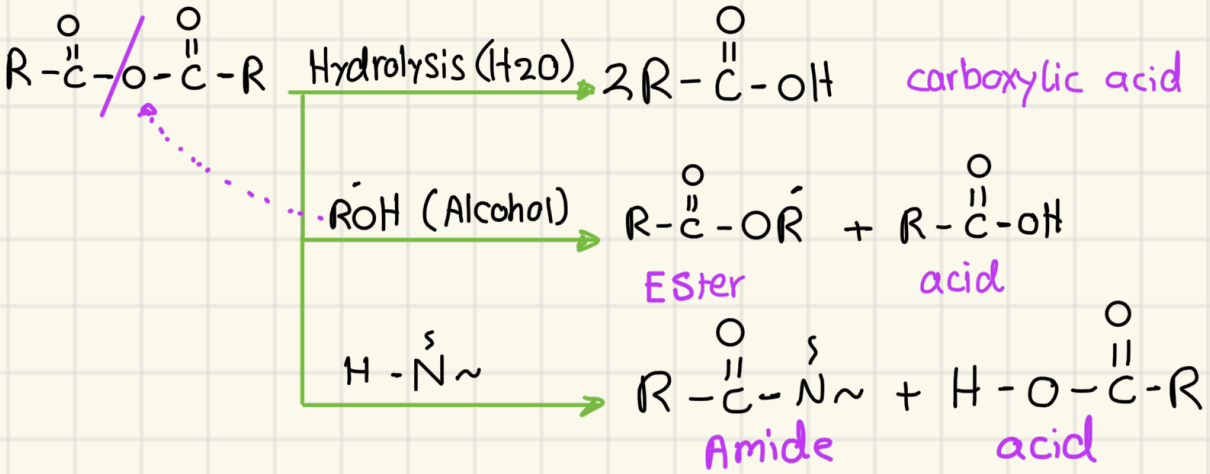
for cyclic Anhydride $-C(=O)-OH$ مركب فيه مجموعتين

Heating of dicharboxylic acids

ex

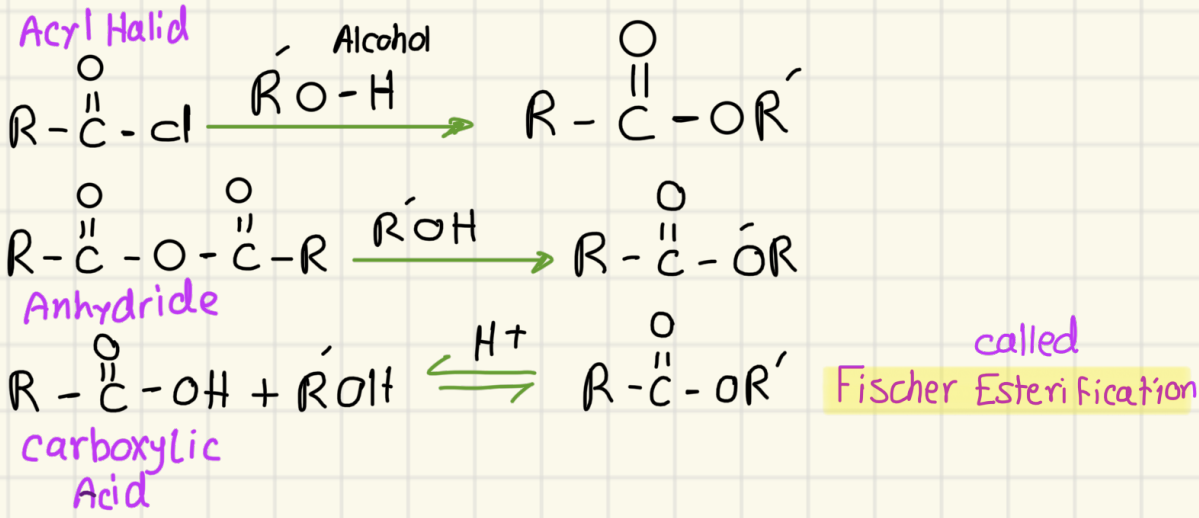


Reactions

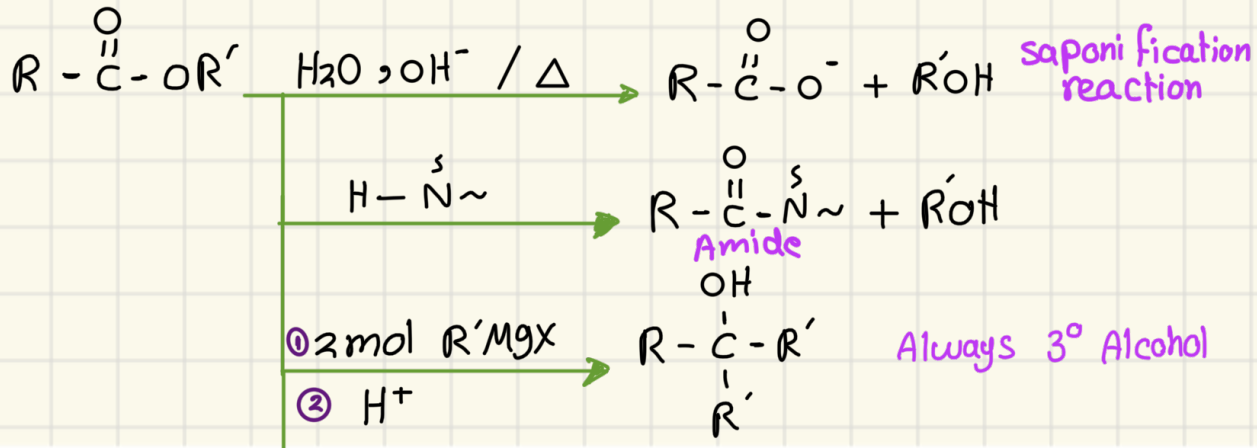


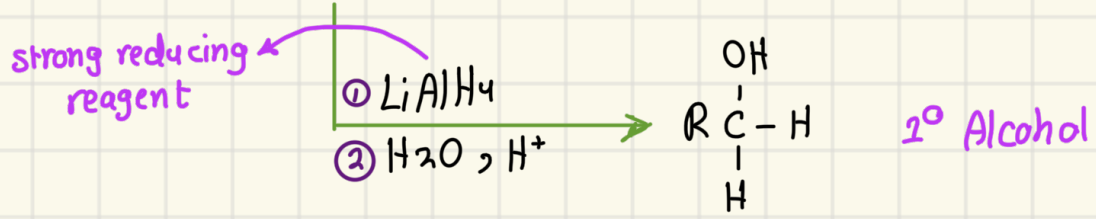
• Esters

Synthesis



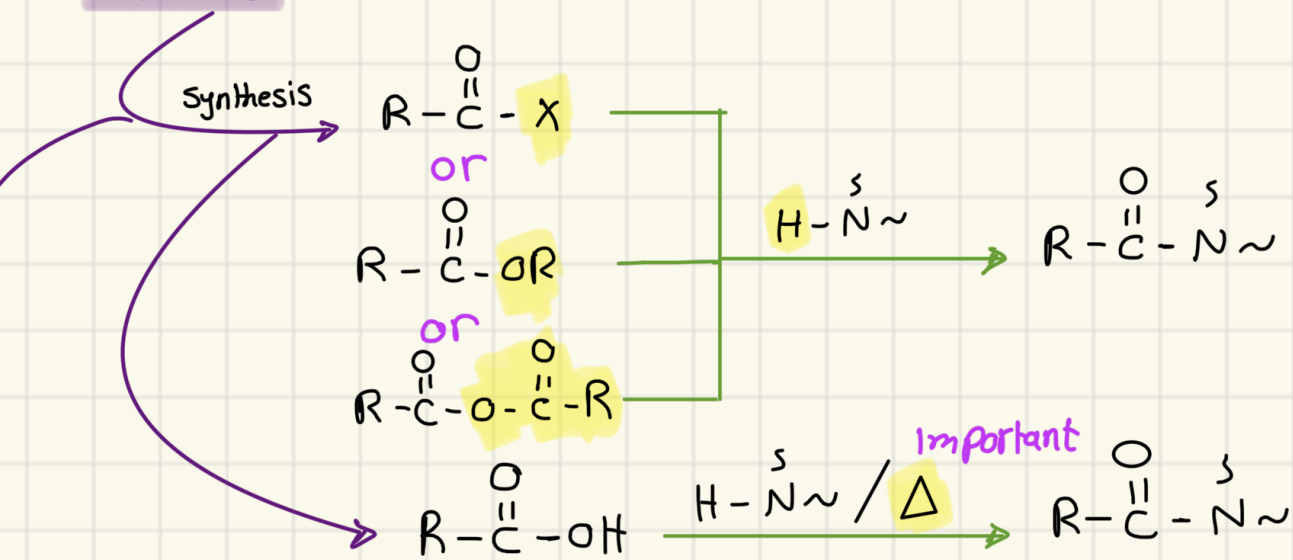
Reactions

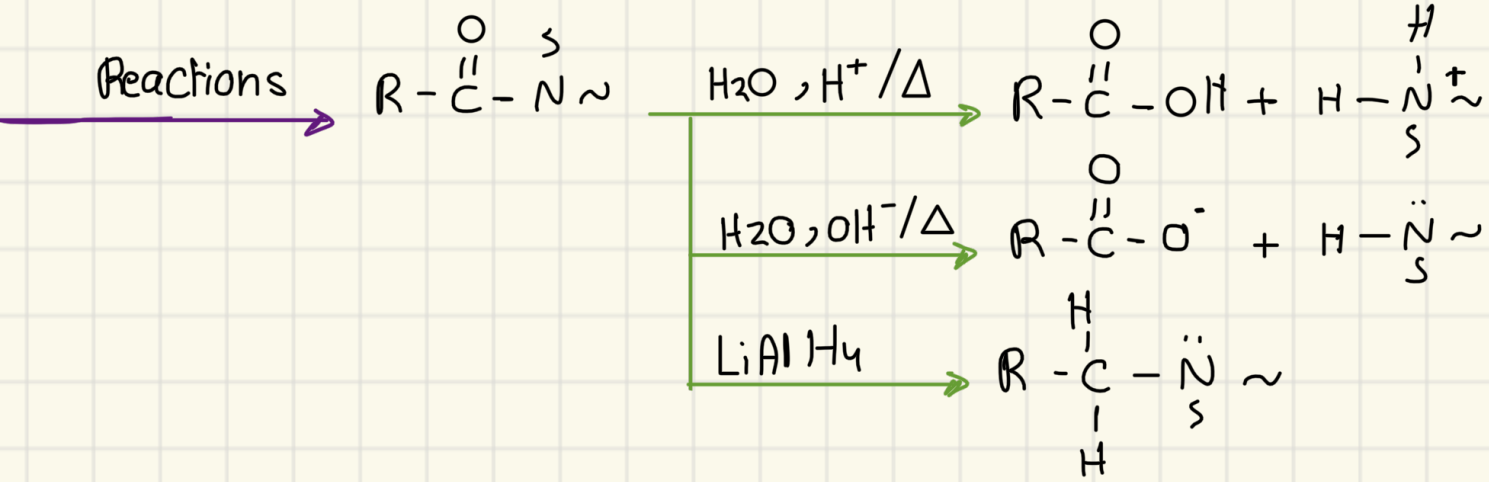




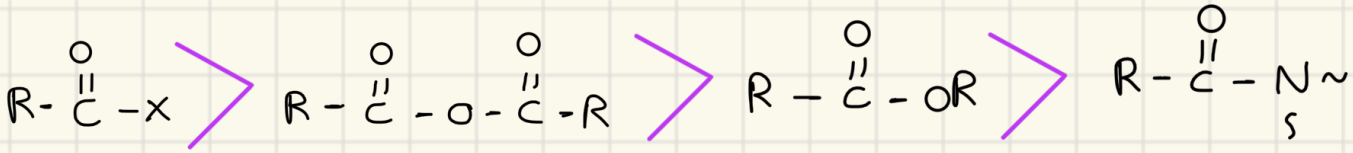
- Note : $NaBH_4$ is weak and affects on Aldehyde and Ketone only
  $LiAlH_4$ is strong and affects on Aldehyde , Ketone , Ester and Amide

- Amide





- The order of reactivity of Nucleophilic acyl Subtitution



most reactive

least reactive