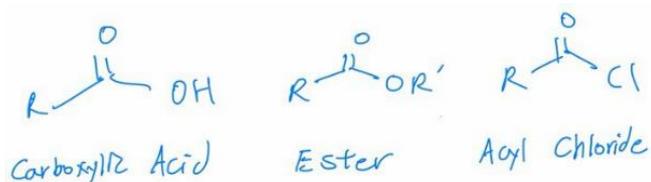


## Carboxylic Acid and Derivatives



## Preparation of Carboxylic Acids

Oxidation of Primary Alcohol/Aldehyde → Carboxylic Acid

- Refer to Hydroxy Compounds Masterclass

Oxidative Cleavage of Alkene → Carboxylic Acid

- Refer to Alkenes Masterclass

Side Chain Oxidation of arenes → carboxylic acid

- Refer to Arenes Masterclass

Hydrolysis of -CN → Carboxylic Acid

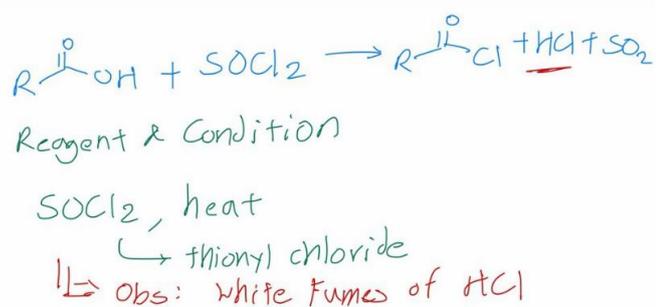
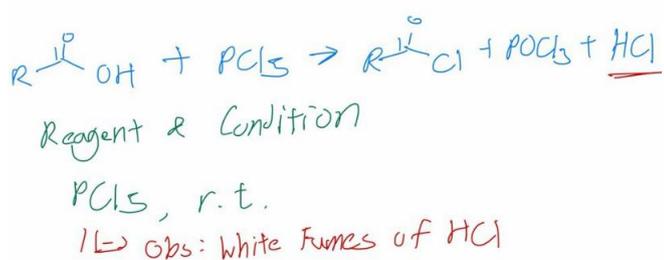
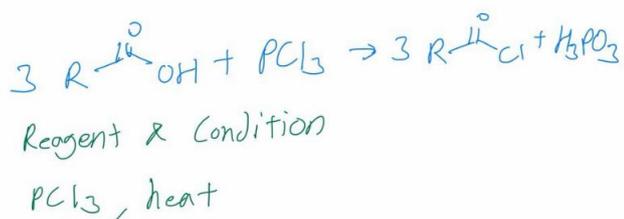
- Refer to Halogen Derivatives Masterclass

## Reaction of Carboxylic Acids

### Esterification

- Refer to Hydroxy Compounds Masterclass

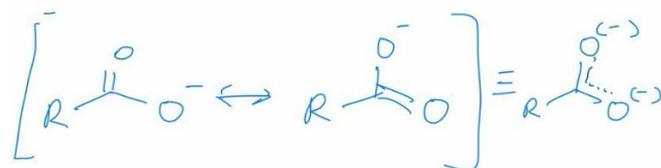
## Preparation of Acyl Chloride



## Acidity

Carboxylic Acid stronger acid than phenol and alcohol

- $\text{RCO}_2^-$  forms resonance structures → delocalization of negative charge over 2 highly electronegative O atoms → stabilization of anion = energetically favoured to form



Note: Refer to Hydroxy Compounds Masterclass for acidity of phenols and alcohols, make sure to use explanations found there when comparing.

Note: Number, Proximity, Strength of electron-donating / electron-withdrawing are factors which affect acidity → affect negative charge of anion

## Reduction of Carboxylic Acid → Alcohol

- Refer to Hydroxy Compounds Masterclass

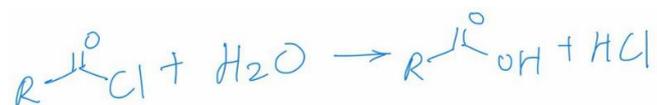
## Distinguishing Test of Carboxylic Acid

Test:  $\text{Na}_2\text{CO}_3$  aq, at r.t.

↳ Obs: effervescence of  $\text{CO}_2$  form white ppt in  $\text{CaCO}_3$ .

## Reaction of Acyl Chloride

### Hydrolysis of Acyl Chloride



### Comparison

#### Acyl Chloride

- Easiest for hydrolysis
- Higher  $\delta^+$  on C, as bonded to strongly electronegative O and Cl
  - o Attracts nucleophile more strongly
- Lesser Steric hindrance  $\rightarrow$  trigonal planar C
- Reaction with  $\text{AgNO}_3$  (aq)
  - o White ppt of  $\text{AgCl}$  observed immediately

#### $\text{RCH}_2\text{Cl}$

- Harder to hydrolyse than acyl chloride
- Lower  $\delta^+$  on C as bonded to only 1 electronegative Cl
  - o Attracts nucleophile less strongly
- C-Cl bond cleaves only with heating
- More steric hindrance  $\rightarrow$  tetrahedral C
- Reaction with  $\text{AgNO}_3$  (aq)
  - o White ppt of  $\text{AgCl}$  observed after prolonged boiling
  - o Faster with ethanolic  $\text{AgNO}_3$

#### ArCl

- Hardest to hydrolyse
- Overlapping of p-orbital on Cl atom with pi electron cloud of benzene ring
  - o Attracts nucleophile less strongly
  - o C-Cl bond has partial double bond character
    - No cleavage occurs due to stronger bond
- Electron-rich benzene repels nucleophile
- Steric hindrance from benzene ring
- Reaction with  $\text{AgNO}_3$  (aq)
  - o No ppt after prolonged boiling or with ethanolic  $\text{AgNO}_3$

## Esterification

- Refer to Hydroxy Compounds Masterclass

## Preparation of Ester

- Refer to Hydroxy Compounds Masterclass

## Reaction of Ester

### Hydrolysis

Acidic hydrolysis of Ester



Basic Hydrolysis of Ester.



### Reduction of Ester to Alcohol



Reagent & Condition

$\text{LiAlH}_4$  in dry ether, r.t.