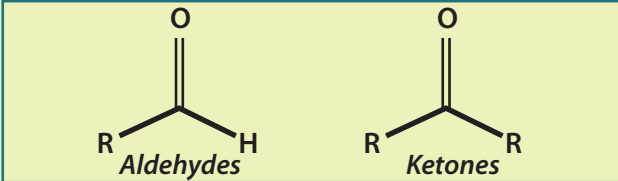
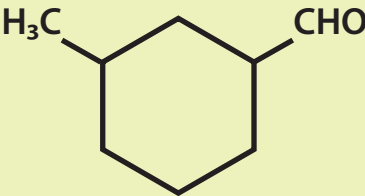
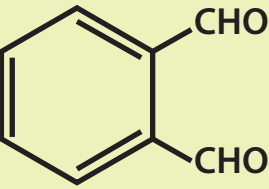
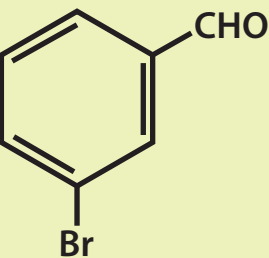
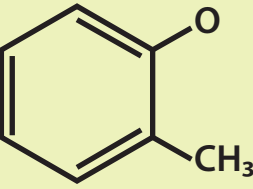


Carbonyl Compounds

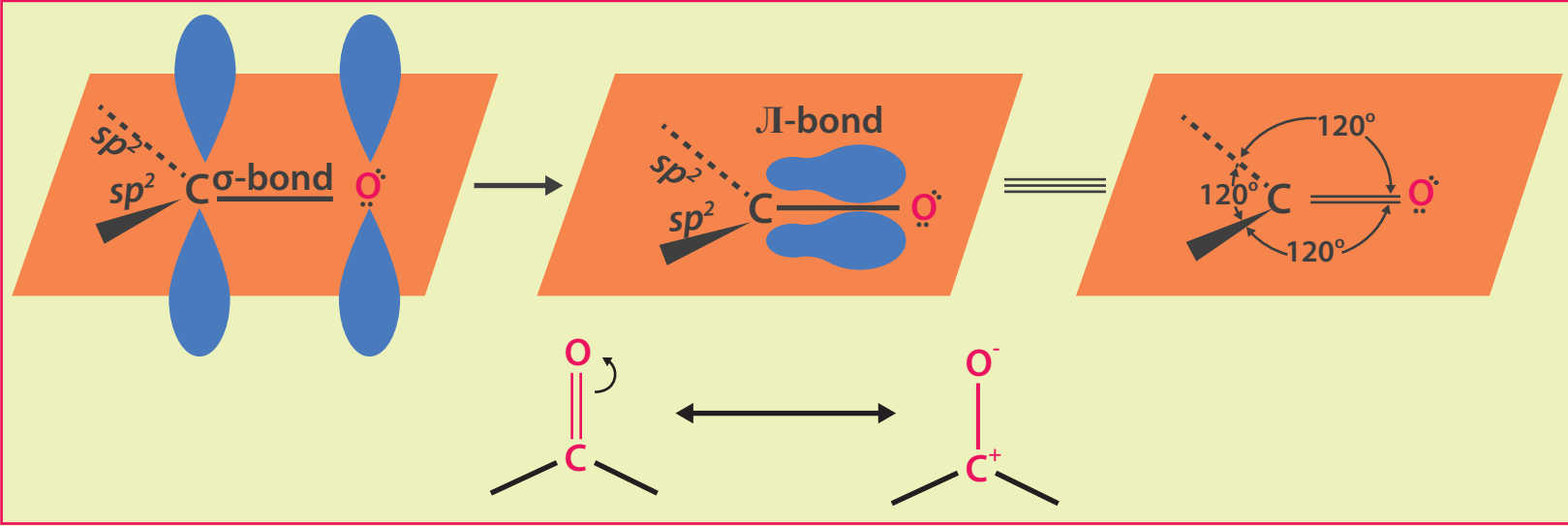
Nomenclature of Carbonyl Group

Carbonyl group is a functional group composed of a carbon atom double bonded to an oxygen atom



Structure	Common Name	IUPAC Name
Aldehydes HCHO CH ₃ CHO (CH ₃) ₂ CHCHO 	Formaldehyde Acetaldehyde Isobutyraldehyde γ-Methylcyclohexanecarbaldehyde	Methanal Ethanal 2-Methylpropanal 3-Methylcyclohexanecarbaldehyde
CH ₃ CH(OCH ₃)CHO CH ₃ CH ₂ CH ₂ CH ₂ CHO CH ₂ =CHCHO 	α-Methoxypropionaldehyde Valeraldehyde Acrolein Phthalaldehyde	2-Methoxypropanal Pentanal Prop-2-enal Benzene- 1,2-dicarbaldehyde
	<i>m</i> -Bromobenzaldehyde	3-Bromobenzenecarbaldehyde or 3-Bromobenzaldehyde
Ketones CH ₃ COCH ₂ CH ₂ CH ₃ (CH ₃) ₂ CHCOCH(CH ₃) ₂  (CH ₃) ₂ C=CHCOCHCH ₃	Methyl n-propyl ketone Diisopropyl ketone α-Methylcyclohexanone Mesityl oxide	Pentan-2-one 2,4-Dimethylpentan-3-one 2-Methylcyclohexanone 4-Methylpent-3-en-2-one

Structure of Carbonyl Group

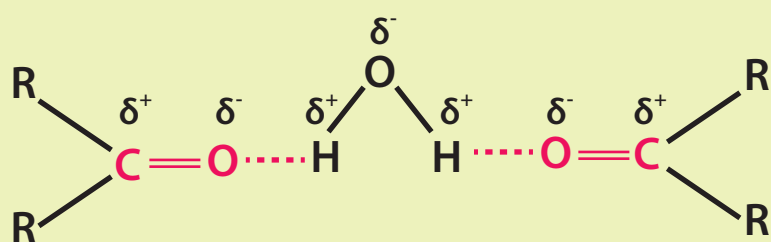


Uses of Aldehydes and Ketones

- Used as a solvent, starting material and reagent
- **Formaldehyde** - Formalin (40%) solution used to preserve biological specimens and to prepare bakelite, urea-formaldehyde glues and other polymeric products
- **Acetaldehyde** - Used primarily as a starting material in the manufacture of acetic acid, ethyl acetate, vinyl acetate, polymers and drugs
- **Benzaldehyde** - Used in perfumery and in dye industries.
Acetone and ethyl methyl ketone are common industrial solvents

Physical Properties

- Methanal (HCHO) is a gas at room temperature
- Ethanal (CH₃CHO) is a volatile liquid
- The boiling points of aldehydes and ketones are higher than hydrocarbons and ethers of similar molecular mass.
- Aldehydes and ketones have lower boiling point than those of alcohols of similar molecular mass
- The lower members of aldehydes and ketones are miscible with water due to the formation of hydrogen bond with water



Carbonyl Compounds

Chemical Properties

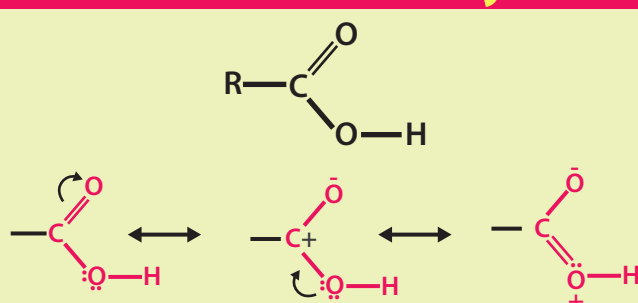
- NaHSO₃ →
- HCN →
- i) RMgX → Alcohols
- ii) H₃O⁺
H₂N-Z (Ammonia Derivates) →
- OH⁻ → Alpha-H containing carbonyl compounds give Aldol reaction
- OH⁻ → Aldehydes without alpha-H undergo Cannizzaro's reaction
- Al(OR)₃ → Ester (Given by two equivalents of an aldehyde)
- Tishchenko reaction
- Zn-Hg
Conc. HCl → Alkane (Clemmensen reduction)
- NH₂-NH₂
OH⁻/Δ → Alkane (Wolf Kishner reduction)
- LiAlH₄ or NaBH₄ → Alcohol
- Oxidation → Carboxylic Acids

Carboxylic acids

Classification

- Monocarboxylic acids contain one -COOH group
- Dicarboxylic acids contain two -COOH groups

Structure of Carboxyl Group

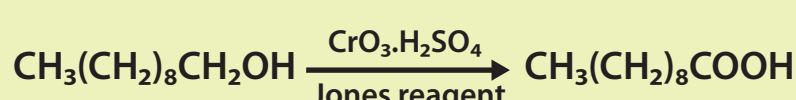
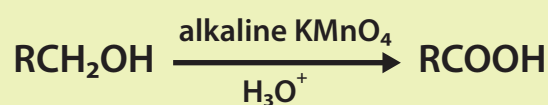


Sources

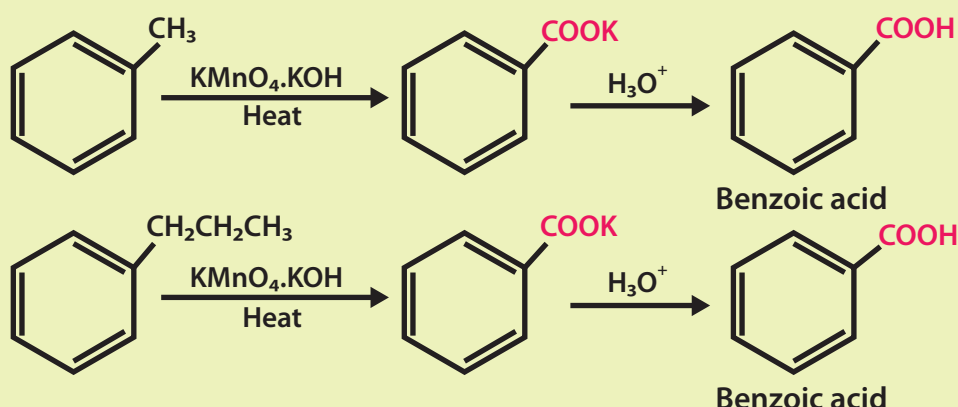
Formula	Common Name	Source
HCOOH	Formic acid	Red ant (Latin: formica)
CH ₃ COOH	Acetic acid	Vinegar (Latin: acetum)
C ₃ H ₇ COOH	Butyric acid	Rancid butter (Latin: butyrum)

Preparation of Carboxylic acids

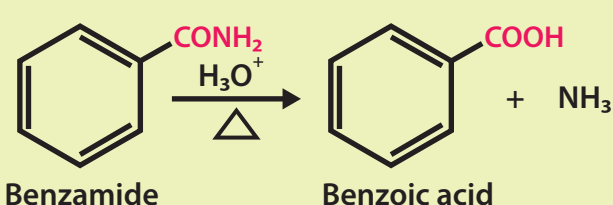
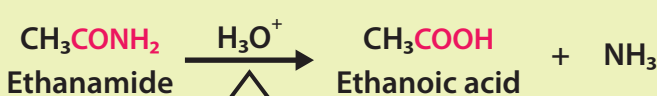
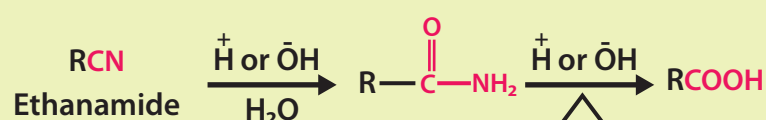
1 From primary alcohols and aldehydes



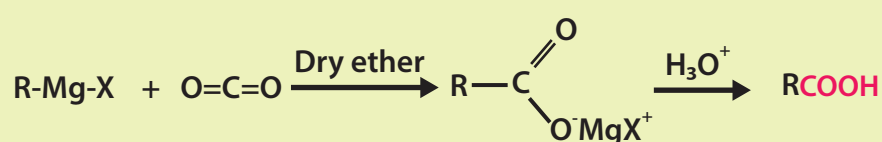
2 From alkylbenzenes



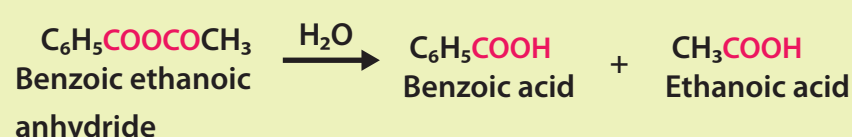
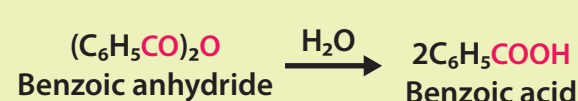
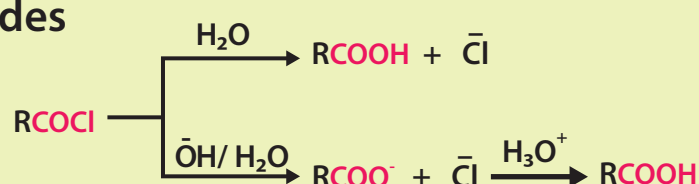
3 From nitriles and amides



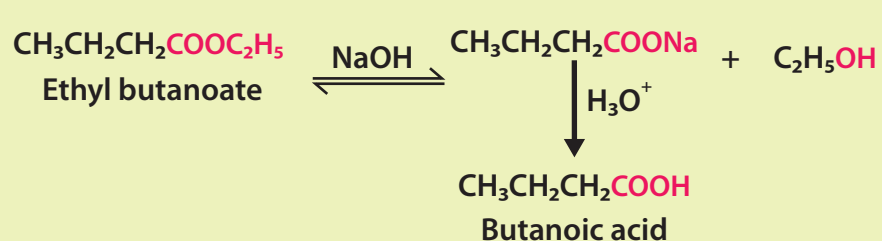
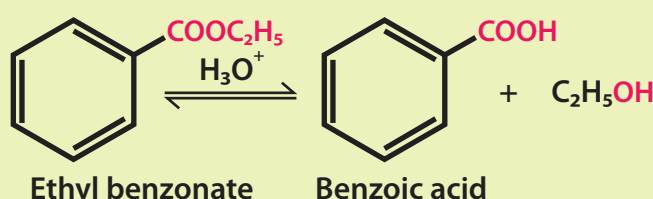
4 From Grignard reagents



5 From Acyl halides and anhydrides

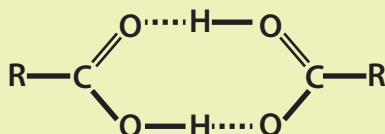


6 From Esters



Physical Properties

- Aliphatic carboxylic acids up to nine carbon atoms are colourless liquids at room temperature with unpleasant odours.
- Lower aliphatic carboxylic acids are miscible in water.
- Carboxylic acids have higher boiling points than aldehydes, ketones and carboxylic acids of similar molecular masses.
- Aliphatic carboxylic acids may show oscillation or alternation effect in which the melting point of an acid with even number of carbon atoms is more than that of the next odd homologue.
- The pure or water free form of acetic acid is also called glacial acetic acid.

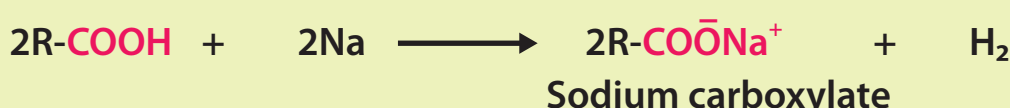


Uses of Carboxylic acid

- Methanoic acid:** Rubber, textile, dyeing, leather and electroplating industries
- Ethanoic acid:** Used as solvent and as vinegar in food industry
- Hexanedioic acid:** Used in the manufacture of nylon-6, 6
- Esters of benzoic acid:** Used in perfumery
- Sodium benzoate:** Used as a food preservative
- Higher fatty acids:** Used for the manufacture of soaps and detergents

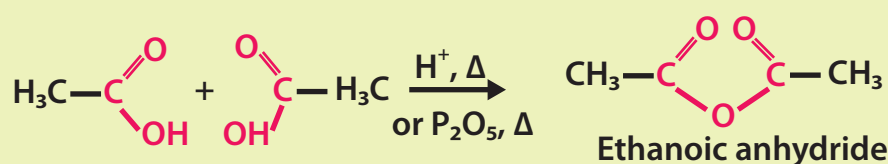
Chemical Properties

Reactions Involving Cleavage of O-H Bond

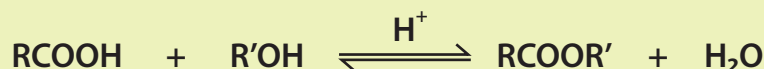


Reactions Involving Cleavage of C-OH Bond

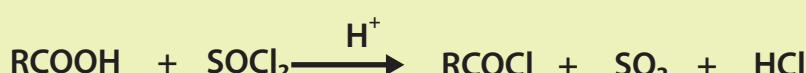
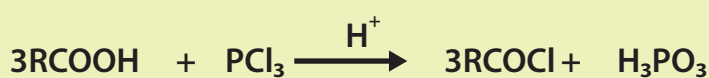
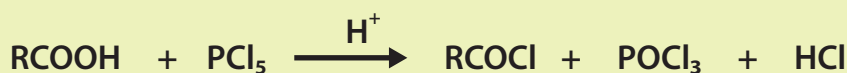
1 Formation of anhydride



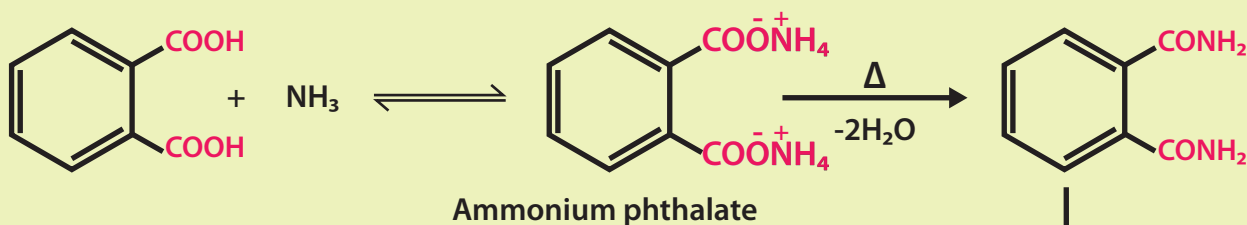
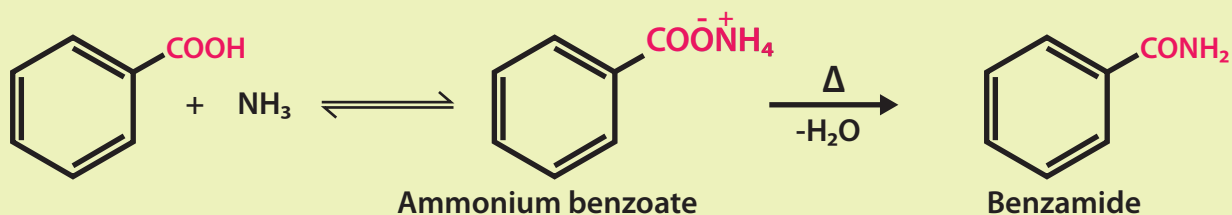
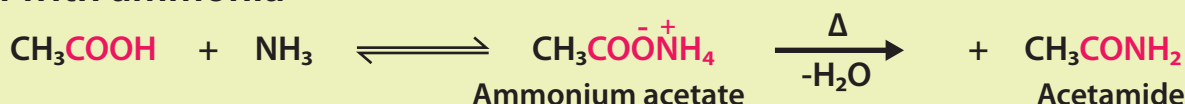
2 Esterification



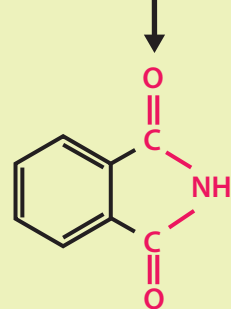
3 Reactions with PCl₅, PCl₃ and SOCl₂



4 Reaction with ammonia



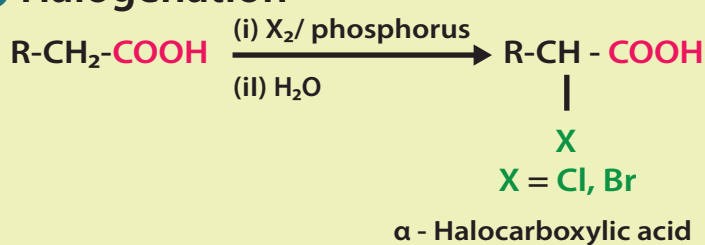
-NH₃ Strong heating



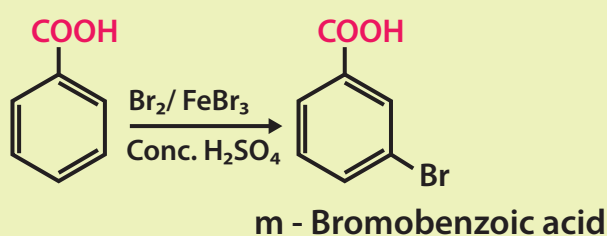
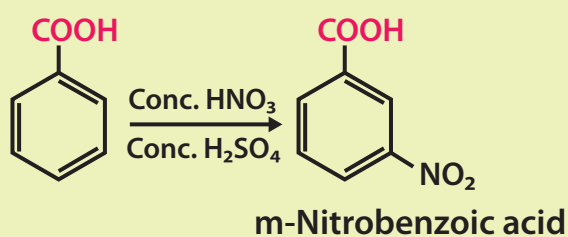
Phthalimide

Reactions Involving -COOH Group

1 Halogenation

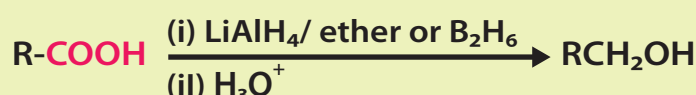


2 Ring Substitution



Reactions Involving -COOH Group

3 Reduction



4 Decarboxylation

