

Aldehydes, Ketones and Carboxylic Acids

the $C=O$ carbon is electrophilic, so a nucleophile always attacks there first, no matter what happens after

Aldehyde vs Ketone vs Carboxylic Acid *

Aldehyde, $-CHO$

- carbonyl carbon bonded to at least one H
- aliphatic if $-CHO$ sits on sp^3 carbon (formaldehyde too). aromatic if it sits on the ring

Ketone, $>C=O$

- carbonyl carbon bonded to two alkyl/aryl groups
- simple/symmetrical if the two groups match, mixed/unsymmetrical if they differ

Carboxylic acid, $-COOH$

- carbonyl carbon ALSO bonded to $-OH$, distinct from a plain carbonyl
- mono/di/tri-carboxylic by how many $-COOH$ groups it carries

aromatic acids need $-COOH$ directly on the ring; on a side-chain carbon it is still ALIPHATIC

Nomenclature: Aldehydes and Acids Are Related

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- trivial names: an aldehyde's name swaps its acid's $-ic$ acid for $-aldehyde$: acetic acid to acetaldehyde
- substituent position uses Greek letters: alpha next to the carbonyl carbon, then beta, gamma
- IUPAC: alkane's $-e$ to $-al$ for an aldehyde, to $-oic$ acid for an acid
- a double $-CHO$ gets $-dial$, the $-e$ kept. a double $-COOH$ gets $-dioic$ acid
- the $-CHO$ or $-COOH$ carbon is ALWAYS C1: the group sits at a chain end
- on a ring, $-CHO$ is **carbaldehyde** and $-COOH$ is **carboxylic acid**, added after the cycloalkane name

Nomenclature: Ketones *

- trivial: groups on the carbonyl carbon, alphabetically, + 'ketone', e.g. ethyl methyl ketone
- aromatic ketones use $-phenone$: acetophenone, benzophenone
- IUPAC: alkane's $-e$ to $-one$, numbered for the LOWER locant. two carbonyls use $-dione$, $-e$ retained
- as the lower-priority group in a polyfunctional molecule: prefix 'oxo-' with its locant instead

Preparing Aldehydes and Ketones: the General Routes

- oxidation: 1° alcohol gives an aldehyde, 2° gives a ketone. hot Cu vapour does the same industrially
- ozonolysis of an alkene, ozonide then Zn/water workup, cleaves $C=C$ to aldehydes and/or ketones
- hydration of an alkyne, $40\% H_2SO_4/1\% HgSO_4$: ethyne gives an aldehyde, any other alkyne a ketone