

Aldehydes and Ketones

Nomenclature and Properties

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Carbonyl Compounds

- Carbon is sp^2 hybridized.
- C=O bond is shorter, stronger, and more polar than C=C bond in alkenes.

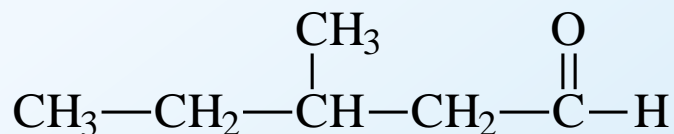
TABLE 18-1 Some Common Classes of Carbonyl Compounds

Class	General Formula	Class	General Formula
ketones	$\begin{array}{c} \text{O} \\ \parallel \\ \text{R}-\text{C}-\text{R}' \end{array}$	aldehydes	$\begin{array}{c} \text{O} \\ \parallel \\ \text{R}-\text{C}-\text{H} \end{array}$
carboxylic acids	$\begin{array}{c} \text{O} \\ \parallel \\ \text{R}-\text{C}-\text{OH} \end{array}$	acid chlorides	$\begin{array}{c} \text{O} \\ \parallel \\ \text{R}-\text{C}-\text{Cl} \end{array}$
esters	$\begin{array}{c} \text{O} \\ \parallel \\ \text{R}-\text{C}-\text{O}-\text{R}' \end{array}$	amides	$\begin{array}{c} \text{O} \\ \parallel \\ \text{R}-\text{C}-\text{NH}_2 \end{array}$

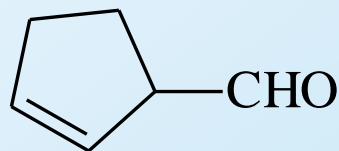
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Nomenclature Aldehydes

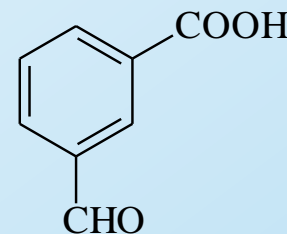
- IUPAC: Replace *-e* with *-al*.
- The aldehyde carbon is number 1.
- If -CHO is attached to a ring, use the suffix *-carbaldehyde*.
- On a molecule with a higher priority functional group, C=O is *oxo-* and -CHO is *formyl*.
- Aldehyde priority is higher than ketone.



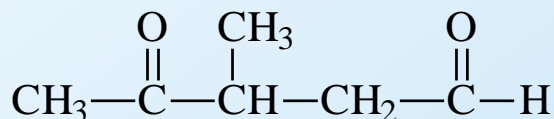
3-methylpentanal



2-cyclopentenecarbaldehyde
cyclopent-2-en-1-carbaldehyde



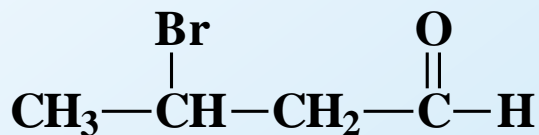
3-formylbenzoic acid



3-methyl-4-oxopentanal

Common Names of Aldehydes

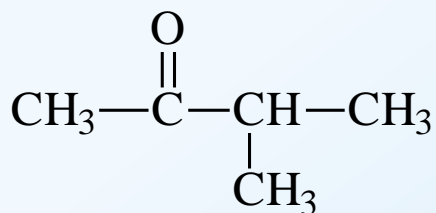
- Use the common name of the acid.
- Drop *-ic acid* and add *-aldehyde*.
 - 1 C: formic acid (HCOOH), formaldehyde (HCHO)
 - 2 C's: acetic acid (CH₃COOH), acetaldehyde (CH₃CHO)
 - 3 C's: propionic acid (CH₃CH₂COOH), propionaldehyde (CH₃CH₂CHO)
 - 4 C's: butyric acid (CH₃CH₂CH₂COOH), butyraldehyde (CH₃CH₂CH₂CHO)



β-bromobutyraldehyde
3-bromobutanal

Nomenclature Ketones

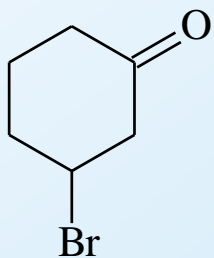
- Replace *-e* with *-one*. Indicate the position of the carbonyl with a number.
- Number the chain so that carbonyl carbon has the lowest number.
- For cyclic ketones the carbonyl carbon is assigned the number 1.



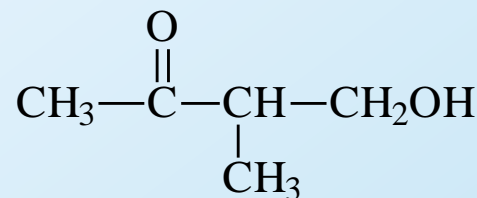
3-methyl-2-butanone

3-methylbutan-2-one

methyl isopropyl ketone

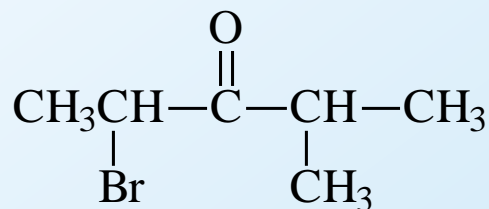


3-bromocyclohexanone

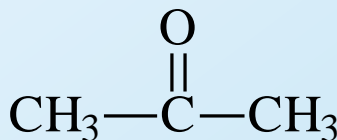


4-hydroxy-3-methyl-2-butanone

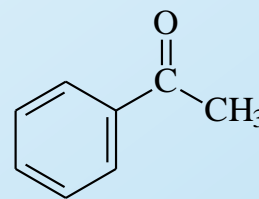
4-hydroxy-3-methylbutan-2-one



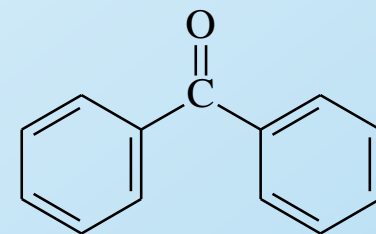
α -bromoethyl isopropyl ketone



acetone



acetophenone

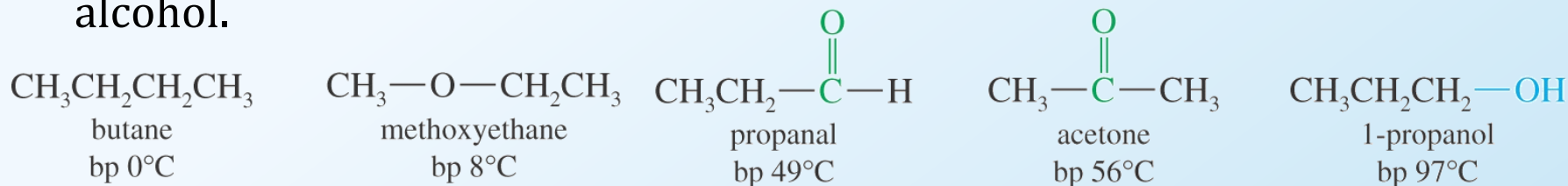


benzophenone

Physical Properties

Boiling Points

- More polar, so higher boiling point than comparable alkane or ether.
- Cannot H-bond to each other, so lower boiling point than comparable alcohol.



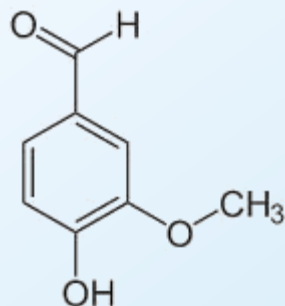
Solubility

- Good solvent for alcohols.
- Lone pair of electrons on oxygen of carbonyl can accept a hydrogen bond from O-H or N-H.
- Acetone and acetaldehyde are miscible in water.
- Odor
- Most ketones are sweet smelling
- Aldehydes have unique aroma – a number of them are used as flavoring agents in food – e.g. vanilla, benzaldehyde.

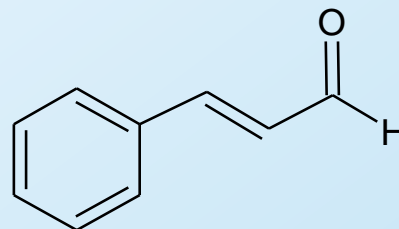
Applications of Aldehyde and Ketones

- Formaldehyde – mixed with water to form formalin which is used as a preservative. Bakelite a polymer is made from formaldehyde and phenol. Some other polymers are formica and plywood.
- Aldehydes Odors– hexanal (fresh cut grass); heptanal (sage); octanal (citrus smell); nonanal (roses); benzaldehyde (almonds), vanillin (3-methoxy-4-hydroxybenzaldehyde), cinnamaldehyde

vanillin



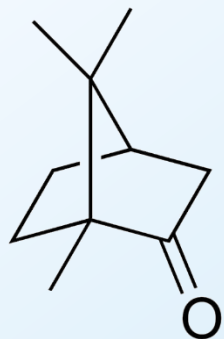
cinnamaldehyde



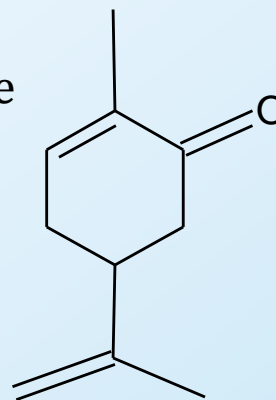
Applications of Ketones

- Acetone – very common solvent
- Terpenes + ketones have sweet odors

camphor

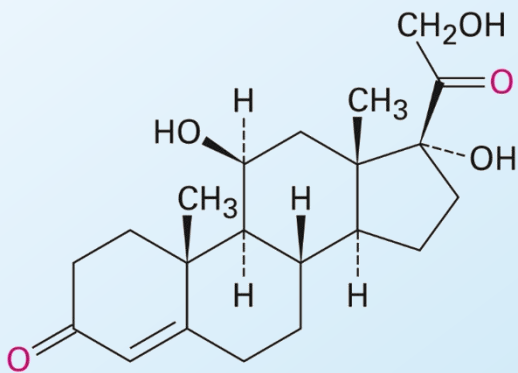


carvone

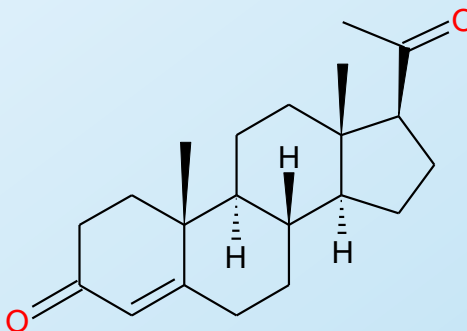


- Steroids.

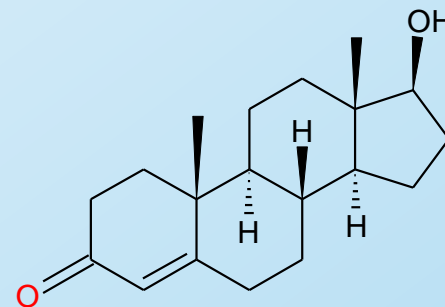
Hydrocortisone



progesterone



testosterone



Key Concepts

- Nomenclature of aldehydes and ketones
 - IUPAC
 - General
- Physical properties
 - Boiling points
 - Solubility in water