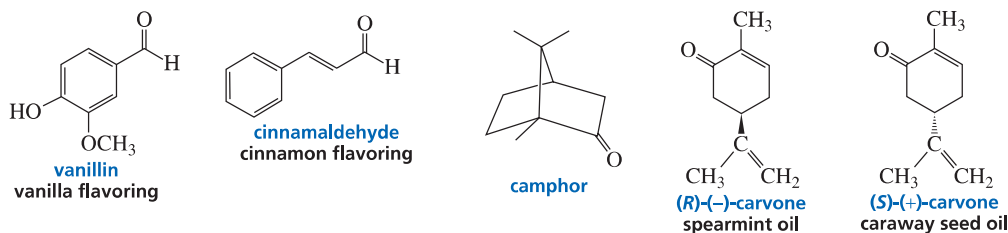
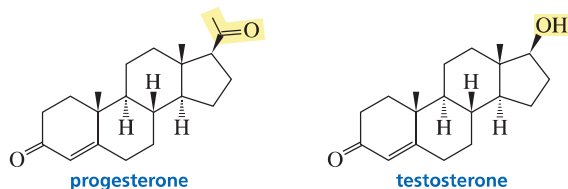


Many compounds found in nature have aldehyde or ketone functional groups. Aldehydes have pungent odors, whereas ketones tend to smell sweet. Vanillin and cinnamaldehyde are examples of naturally occurring aldehydes. A whiff of vanilla extract allows you to appreciate the pungent odor of vanillin. The ketones camphor and carvone are responsible for the characteristic sweet odors of the leaves of camphor trees, spearmint leaves, and caraway seeds.



Progesterone and testosterone are two biologically important ketones that illustrate how a small difference in structure can be responsible for a large difference in biological activity. Both are sex hormones, but progesterone is synthesized primarily in the ovaries, whereas testosterone is synthesized primarily in the testes.



The physical properties of aldehydes and ketones were discussed in Section 15.3 (see also Appendix VI), and the methods used to prepare aldehydes and ketones are summarized in Appendix III.

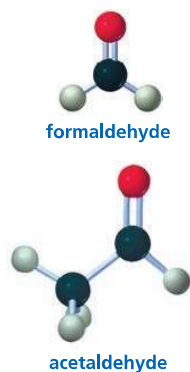
16.1 THE NOMENCLATURE OF ALDEHYDES AND KETONES

Naming Aldehydes

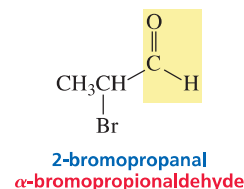
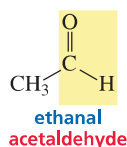
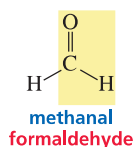
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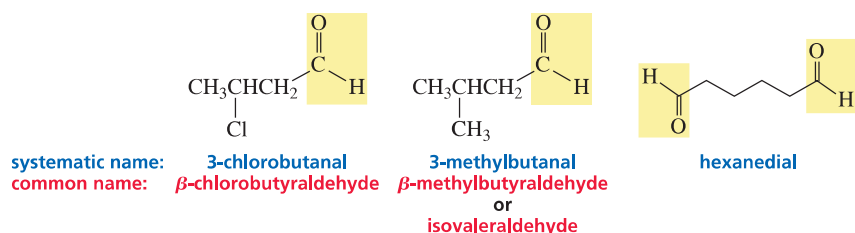
The systematic (IUPAC) name of an aldehyde is obtained by replacing the final “e” on the name of the parent hydrocarbon with “al.” For example, a one-carbon aldehyde is called *methanal*, and a two-carbon aldehyde is called *ethanal*. The position of the carbonyl carbon does not have to be designated because it is always at the end of the parent hydrocarbon (or else the compound would not be an aldehyde), so it always has the 1-position.

The common name of an aldehyde is the same as the common name of the corresponding carboxylic acid, except that “aldehyde” is substituted for “oic acid” (or “ic acid”). Recall that the position of a substituent is designated by a lowercase Greek letter when common names are used. The carbonyl carbon is not given a designation, so the carbon adjacent to the carbonyl carbon is the α -carbon (Section 15.1).



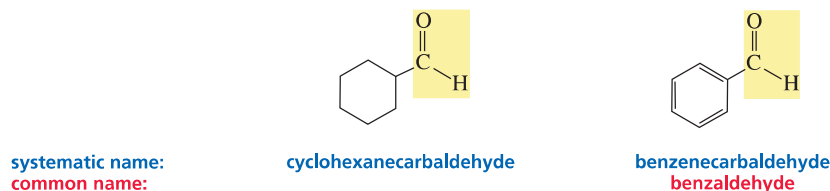
systematic name:
 common name:





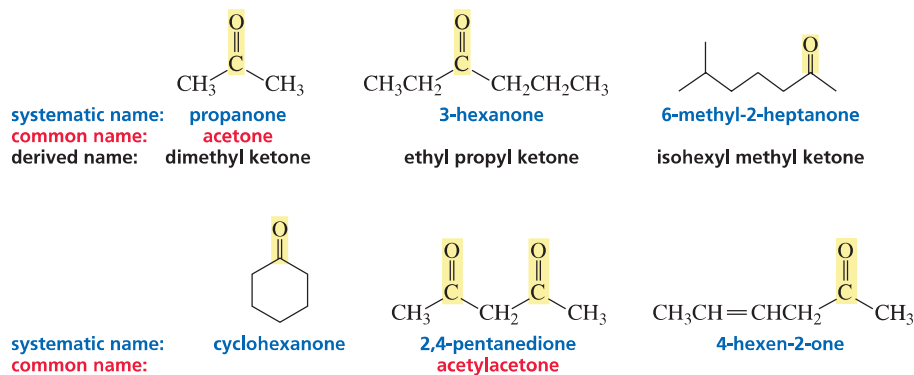
Notice that the terminal “e” of the parent hydrocarbon is not removed in hexanedial. (The “e” is removed only to avoid two successive vowels.)

If the aldehyde group is attached to a ring, then the aldehyde is named by adding “carbaldehyde” to the name of the cyclic compound.

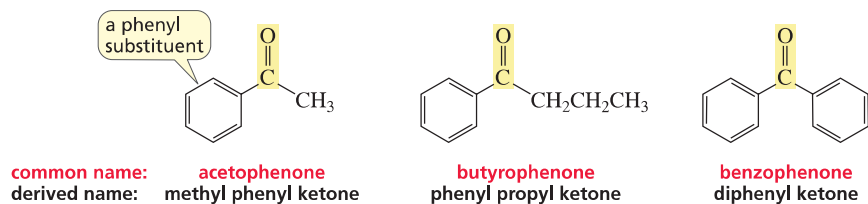


Naming Ketones

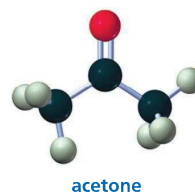
The systematic name of a ketone is obtained by replacing the “e” on the end of the parent hydrocarbon name with “one.” The chain is numbered in the direction that gives the carbonyl carbon the smaller number. Cyclic ketones do not need a number because the carbonyl carbon is assumed to be at the 1-position. Derived names can also be used for ketones. In a derived name, the substituents attached to the carbonyl group are cited in alphabetical order, followed by “ketone.”



Only a few ketones have common names. The smallest ketone, propanone, is usually referred to by its common name, acetone. Acetone is a widely used laboratory solvent. Common names are also used for some phenyl-substituted ketones; the number of carbons (other than those of the phenyl group) is indicated by the common name of the corresponding carboxylic acid, substituting “ophenone” for “ic acid.”



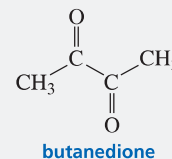
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Aldehydes and ketones are named using a functional group suffix.

Butanedione: An Unpleasant Compound

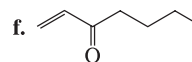
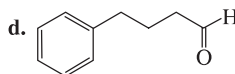
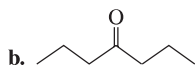
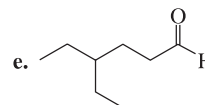
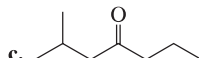
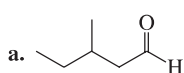
Fresh perspiration is odorless. The smells we associate with perspiration result from a chain of events initiated by bacteria that are always present on our skin. These bacteria produce lactic acid, which creates an acidic environment that allows other bacteria to break down the components of perspiration, producing compounds with the unappealing odors we associate with armpits and sweaty feet. One such compound is butanedione.



USE THE STRATEGY

PROBLEM 1 ♦

Give two names for each of the following:



PROBLEM 2 ♦

Why are numbers not used to designate the position of the functional group in propanone and butanedione?

Naming Compounds with Two Functional Groups

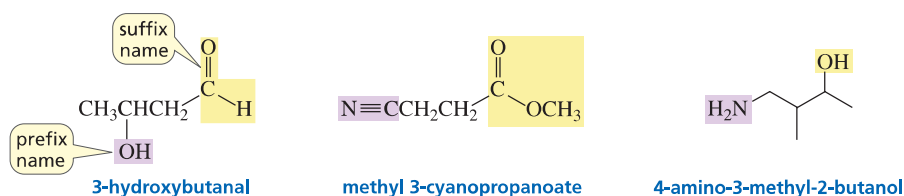
In Section 7.2, we saw that a carbonyl group has a higher nomenclature priority than an alcohol or an amino group. However, all carbonyl compounds do not have the same priority. Nomenclature priorities of the various functional groups, including carbonyl groups, are listed in Table 16.1.

Table 16.1 Functional Group Nomenclature

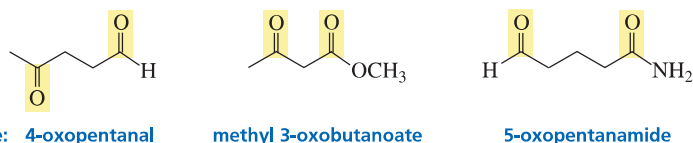
	Class	Suffix name	Prefix name
<p>increasing priority</p>	Carboxylic acid	-oic acid	Carboxy
	Ester	-oate	Alkoxy carbonyl
	Amide	-amide	Amido
	Nitrile	-nitrile	Cyano
	Aldehyde	-al	Oxo (=O)
	Aldehyde	-al	Formyl (CH=O)
	Ketone	-one	Oxo (=O)
	Alcohol	-ol	Hydroxy
	Amine	-amine	Amino
	Alkene	-ene	Alkenyl
	Alkyne	-yne	Alkynyl
	Alkane	-ane	Alkyl
	Ether	—	Alkoxy
	Alkyl halide	—	Halo

LEARN THE STRATEGY

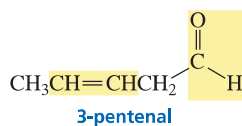
If a compound has two functional groups, the one with the lower priority is indicated by a prefix and the one with the higher priority by a suffix (unless one of the functional groups is an alkene or an alkyne; Section 7.2 and page 743). The parent chain is numbered to give the higher priority functional group the lower number.



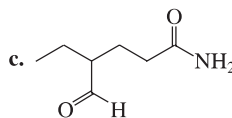
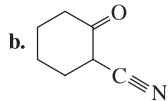
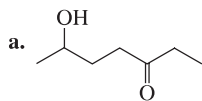
If a ketone or an aldehyde has a second functional group of higher naming priority, the carbonyl oxygen is indicated by the prefix “oxo.”



We saw that if one of the functional groups is an alkene (or an alkyne), suffix endings are used for both functional groups; the alkene (or alkyne) functional group is stated first, with its “e” ending omitted to avoid two successive vowels (Section 7.2).

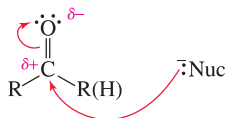
**PROBLEM 3**

Name the following:

**USE THE STRATEGY**

16.2 THE RELATIVE REACTIVITIES OF CARBONYL COMPOUNDS

We saw that the carbonyl group is polar because oxygen is more electronegative than carbon, so oxygen has a greater share of the double bond's electrons (Section 15.5). As a result, the carbonyl carbon is electron deficient (it is an electrophile). Therefore, it reacts with nucleophiles. The electron deficiency of the carbonyl carbon in formaldehyde, acetaldehyde, and acetone is indicated by the faint blue region in each compound's electrostatic potential map.



An aldehyde has a greater partial positive charge on its carbonyl carbon than a ketone does because an alkyl group is more electron donating than a hydrogen (Section 6.2). An aldehyde, therefore, is more reactive than a ketone toward nucleophilic addition. Steric factors also contribute to the greater reactivity of an aldehyde. The carbonyl carbon of an aldehyde is more accessible to a nucleophile because the hydrogen attached to the carbonyl carbon of an aldehyde is smaller than the second alkyl group attached to the carbonyl carbon of a ketone.

relative reactivities