

CHAPTER 5

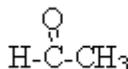
ALDEHYDES AND KETONES

5.1 Introduction

H

Aldehydes have a -C=O functional group. An aldehyde requires that at least one of the bonds on the C=O group is a hydrogen atom. When the carbonyl group (C=O) has two C atoms bonded to it is classified as a ketone.

5.2 Naming Aldehydes and Ketones

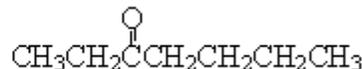
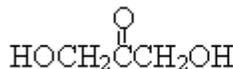
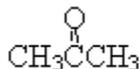


Systematic: methanal ethanal propanal butanal

Common: **formaldehyde** **acetaldehyde**

You should know the common names! They are more commonly used than the systematic names.

Ketones:



Systematic: propanone 1,3-dihydroxypropanone 3-heptanone

Common: **acetone** **dihydroxyacetone(DHA)**

The ketone is assigned a number on the chain starting from whichever end gives the smaller number. It takes priority over branches off the chain.

Methanal (formaldehyde) is a commonly used preservative for biological specimens although concern about it being a mild carcinogen has prompted efforts to reduce its use and to provide very good ventilation when it is used to minimize exposure.

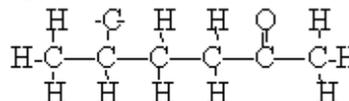
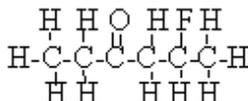
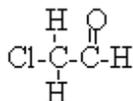
Propanone (acetone) is commonly used in nail polish remover. It is also a metabolic product sometimes formed by diabetics who are not controlling their blood sugar. It is readily detected, because it makes the breath smell like nail polish remover or “fruity”, not a normal situation! This condition is called **ketosis**, indicating the presence of ketones in the blood. This condition is also commonly associated with blood acidosis and the combined condition is referred to as **ketoacidosis**.

Dihydroxyacetone is the active ingredient in some sunless sun tanning lotions. It reacts with amino acids in the skin to form **melaninoids** which have a brown color. In its original formulation, it gave an orange tan but improvements in formulations have improved its esthetics considerably. It absorbs primarily in the UV-A range (320-400 nm) but only with a typical SPF of approximately 3 and hence can still leave an individual vulnerable to burning from UV radiation.

Numbering groups off the main chain.

Numbering should start from whichever end of the molecule gives the smaller # for the position of the C atom of the carbonyl (C=O) group. The aldehyde group will automatically be number one and it is not necessary to explicitly number it.

You should minimize the number of the C=O even if it produces a larger number for some other groups such as halogens or alkyl groups branching off the main chain.



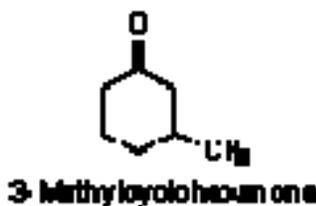
2-chloro(1)ethanal NOT
1-chloro (2)ethanal

5-fluoro-3-hexanone not
2-fluoro-4-hexanone

Ketone groups can occur in rings, for example:

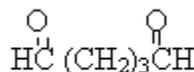
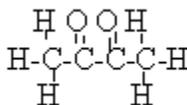
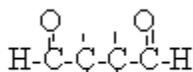
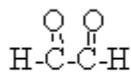


Cyclobutanone



3-methyl (1-)cyclohexanone

We can have multiple aldehyde or ketone functional groups in a molecule:



(1,2)ethanedial

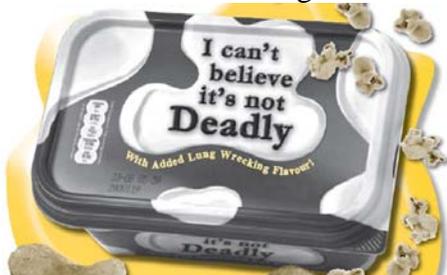
1,4 butanedial

2,3 butanedione
diacetyl

1,5-pentanedial
(glutaraldehyde)

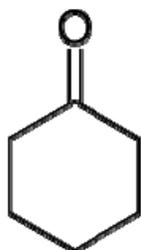
2,3 butanedione(diacetyl) is a natural product formed in very small amounts during yeast fermentation. It contributes to the taste of butter and to some Chardonnay wines. It has been added to artificial butter flavor for many years in margarine and popcorn flavoring. Several cases have come to medical attention where workers in poorly ventilated popcorn production facilities have developed a very rare disease called bronchiolitis obliterans. Although people eating the actual popcorn are exposed to orders of magnitude (~1,000,000) less diacetyl than workers in the popcorn plants, there are

efforts underway to move away from widespread use of diacetyl as an artificial flavoring agent and several popcorn manufacturing companies have already switched to alternative flavoring agents. As in the case of mercury in amalgams, most toxicologists agree that the toxicity depends on the concentrations and that the amount of diacetyl in artificial butter flavor is not enough to cause health problems.



1,5-pentanedial (glutaraldehyde) was used for many years to “fix” microscope slides and as a high level disinfectant which can be used at room temperature for medical equipment which cannot tolerate autoclave temperatures. (What other molecule that we’ve discussed is used for this purpose?) Like formaldehyde, it probably kills bacteria and viruses by reacting (via its aldehyde groups) with cells walls and membranes. It is, however, extremely irritating to human lungs and skin and its use has decreased in recent years as less toxic sterilizing alternatives have been developed.

Ketones in rings

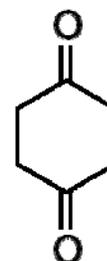


Cyclohexanone
cyclohexanedione

has the real shape



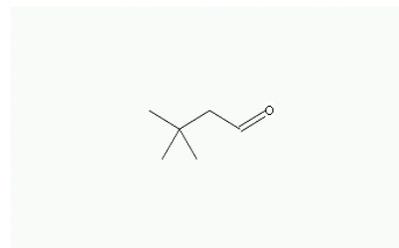
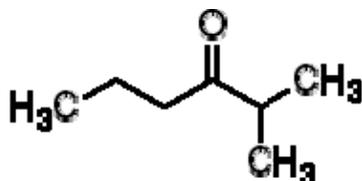
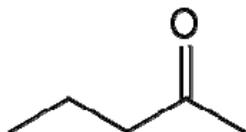
cyclohexanone(chair confirmation)



1,4-

Naming practice:

Try naming these compounds:



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