Aldehydes and ketones

by

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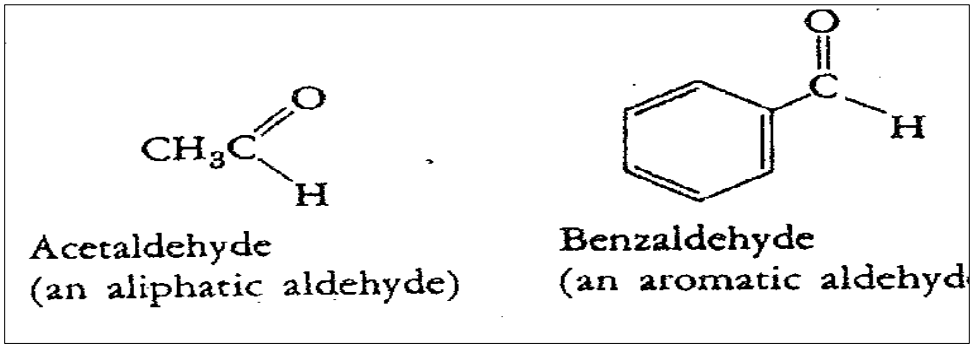
Medical Chemistry

First stage

Collage of Dentistry

Aldehydes and ketones:-

Aldehydes and ketones are two more classes of compounds that contain the carbonyl group. An aldehyde contains a carbonyl group whose carbon is bonded to one hydrogen and either an alkyl or an aryl group. For example

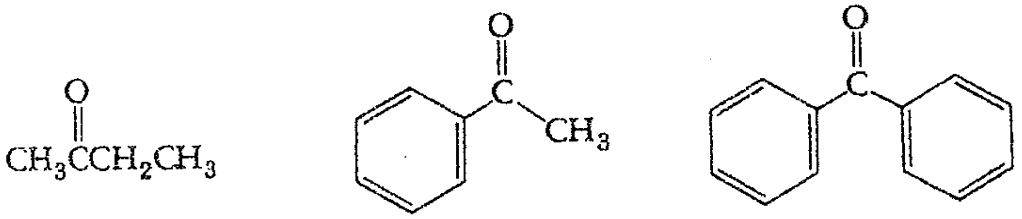


Acetaldehyde
(an aliphatic aldehyde)

Benzaldehyde
(an aromatic aldehyd

The aldehyde group also written RCHO.

A ketone contains a carbonyl group whose carbon is bonded to two alkyl groups, two aryl groups, or one alkyl and one aryl group. The groups need not be identical. For example:



2-Butanone
(an aliphatic ketone)

Acetophenone
(an aryl alkyl ketone)

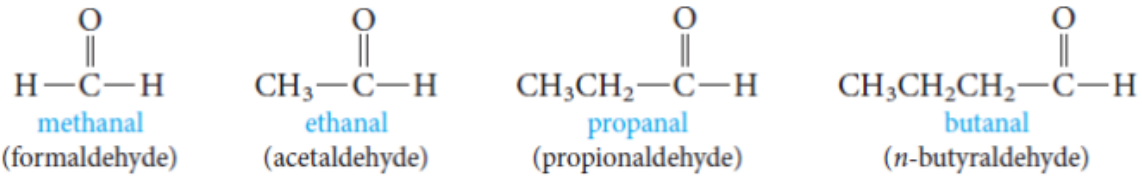
Benzophenone
(an aromatic ketone)

Nomenclature of Aldehydes:-

IUPAC System

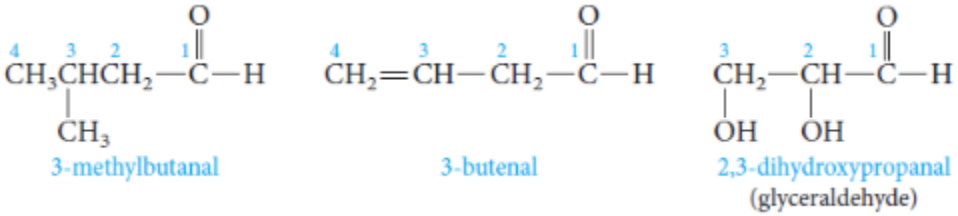
Aliphatic aldehydes are named by dropping the suffix -e from the name of the hydrocarbon that has the same carbon skeleton as the aldehyde and replacing it with the suffix -al.

Alkane - e+ al = Alkanal

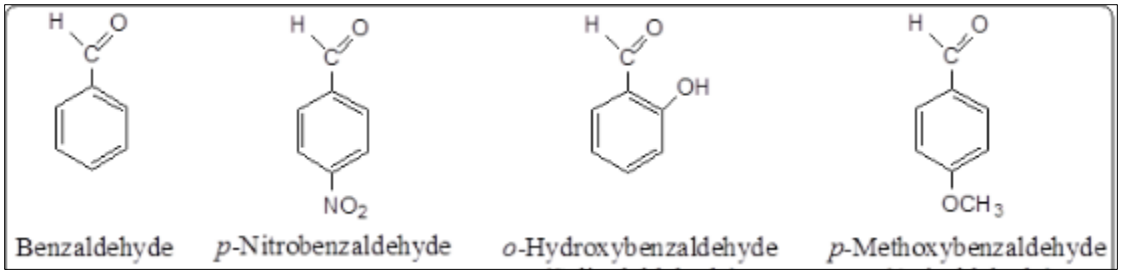


Substituted aldehydes, we number the chain starting with the aldehyde carbon.

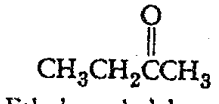
- -CH=O group is assigned the number 1 position.
- Aldehyde group has priority over a double bond or hydroxyl group.



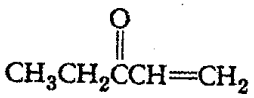
Aromatic aldehydes are usually designated as derivatives of the simplest aromatic aldehyde, benzaldehyde.

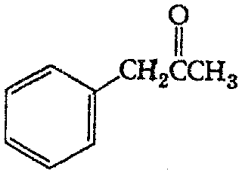


The common names of ketones are formed by placing the names of the groups attached to the carbonyl group as prefixes to the word ketone. The names are written as separate words. For example:

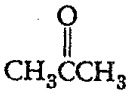

Ethyl methyl ketone

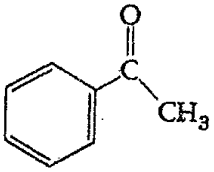

Diethyl ketone

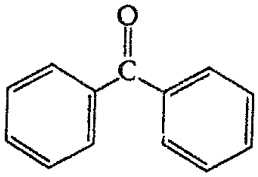

Ethyl vinyl ketone


Benzyl methyl ketone

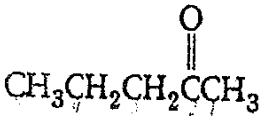
The following ketones are known generally by their trivial names:

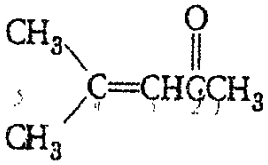

Acetone

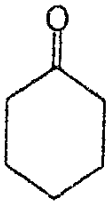

Acetophenone


Benzophenone

The IUPAC names of ketones are derived from the name of the longest carbon chain that contains the carbonyl group by replacing the *-e* with the suffix *-one*. The location of the carbonyl group is designated by the lowest number placed just before the parent name. If another suffix is present, the number indicating the position of the carbonyl group is placed just before its suffix. For example:


2-Pentanone

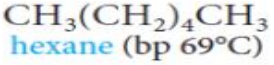

4-Methyl-3-penten-2-one

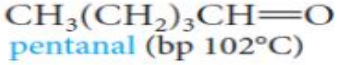

Cyclohexanone

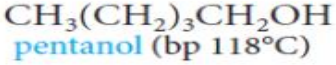
Physical Properties of Aldehydes and Ketone:-

Boiling Points:

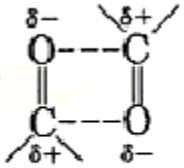
Carbonyl compounds boil at higher temperatures than hydrocarbons, but at lower temperatures than alcohols of comparable molecular weight.


hexane (bp 69°C)


pentanal (bp 102°C)


pentanol (bp 118°C)

This is due to the intermolecular forces of attraction, called dipole-dipole interactions, which is stronger than van der Waals attractions but not as strong as hydrogen bonds



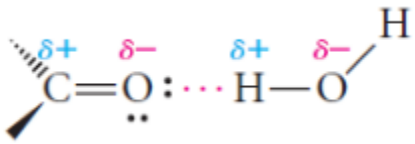
Dipole-dipole attractions among carbonyl compounds

Solubility:-

- Carbonyl compounds as aldehydes and ketones have a C=O bond, but no O-H bond, cannot form hydrogen bonds with themselves.

-The polarity of the carbonyl group also affects the solubility properties of aldehydes and ketones.

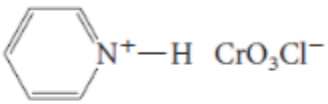
- Carbonyl compounds with low molecular weights are soluble in water as they can form hydrogen bonds with O-H or N-H compounds.



Preparation of Aldehydes and Ketones :-

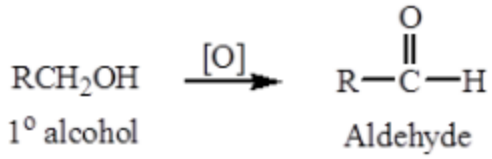
1) **Oxidation of Primary and Secondary Alcohols:**

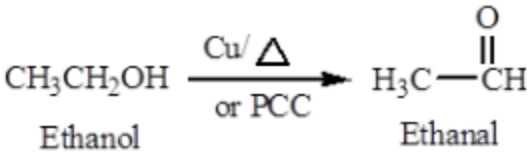
   Chromium reagents, such as pyridinium chlorochromate (PCC), are commonly used in the laboratory.



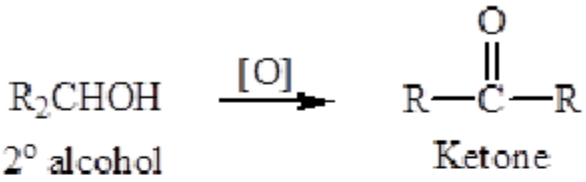
pyridinium chlorochromate (PCC)

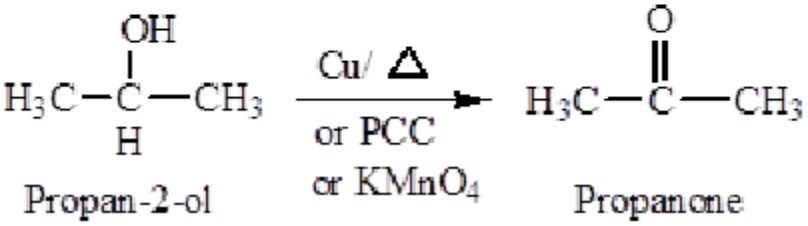
-Oxidation of primary alcohols, under controlled conditions, yields aldehydes.





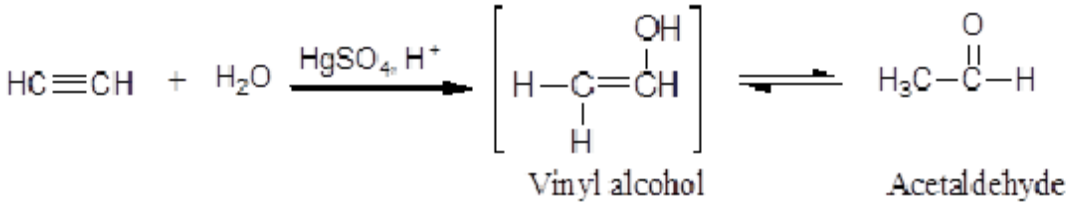
- Oxidation of secondary alcohols yields ketones.



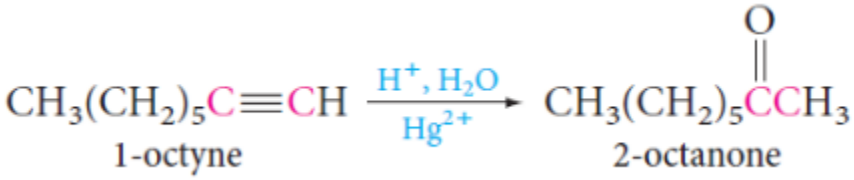


2) **Hydration of Alkynes:**

- Hydration of acetylene yields acetaldehyde (catalyzed by acid and mercuric)

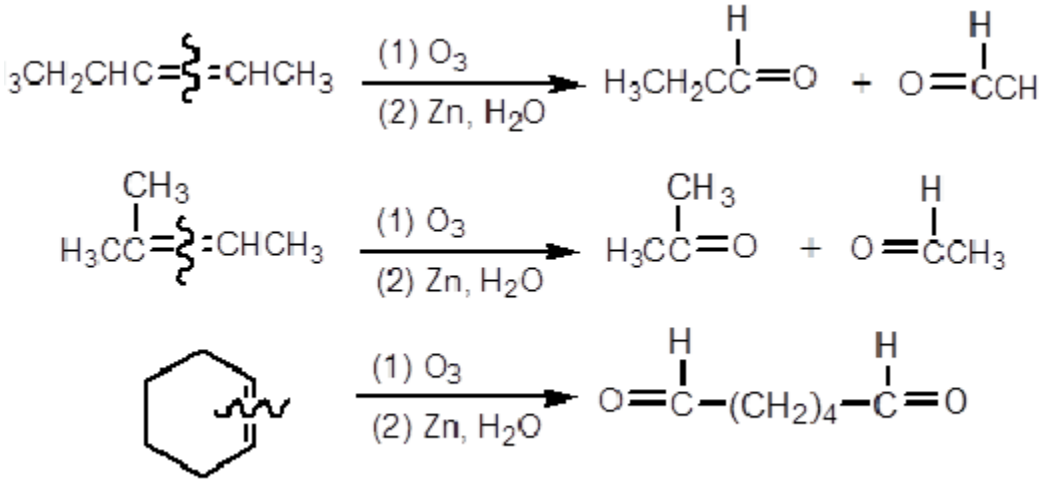


-Hydration of terminal alkynes EXCEPT acetylene yields ketones (catalyzed by acid and mercuric).



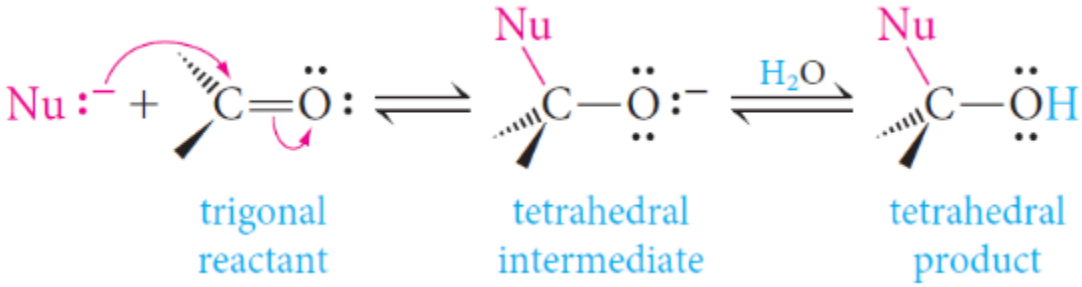
3) Ozonolysis of Alkenes:

Product (aldehyde or ketone) depends on the structure of alkene.



4- Nucleophilic Addition Reactions:-

- Nucleophiles attack the carbon atom of a carbon-oxygen double bond because that carbon has a partial positive charge.
- The overall reaction involves addition of a nucleophile and a proton across the pi bond of the carbonyl group (when carried out in alcohol or water).



References:

The chemical bases of life book.