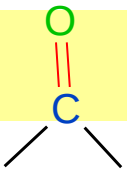
Section 3: Carbonyl Compounds



Carbonyl Group: An arrangement in which the oxygen atom is bonded with a carbon atom with a covalent double bond**.**

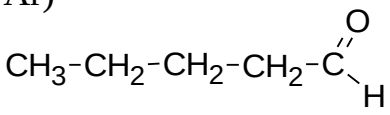
(Aldehydes - Ketones - Carboxylic acids - Esters – Amides)

Aldehydes

Aldehyde: A compound consisting of a series of carbon atoms, at the end of which is a carbonyl group connected from one end of a carbon atom, and from the other end a hydrogen atom.

General formula for the aldehydes: * -CHO (* = H / R/Ar)

Note: -CHO terminal group**.**



Naming of aldehydes:

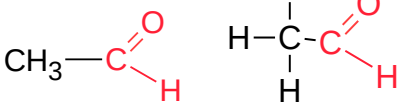
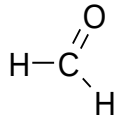
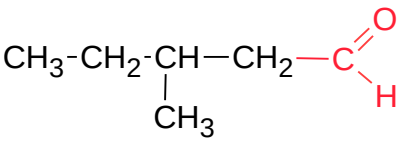
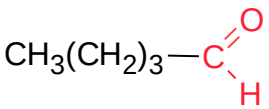
1 - Add the suffix (**-ol**) to the name of the alkanes that have the same number of carbon atoms (carbon atoms include the functional group)

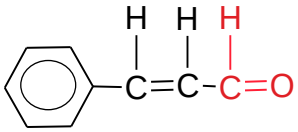
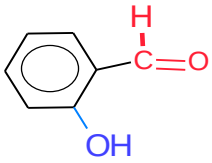
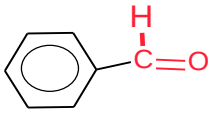
2 - no need to use numbers except when there are branches or other functional groups**.**

Note: Scientists often use the **common names** for organic compounds because they are **familiar to chemists**

Trainings

■ **Figure 22.9** A water solution of formaldehyde was used in the past to preserve biological specimens. However, formaldehyde's use has been restricted in recent years because studies indicate it might cause cancer.

CH_3CHO  Ethanal (acetaldehyde)	 **Methanal** (**formaldehyde**) (Used to keep dead body objects for several years) 
CH_3-CH_2-CHO	**formaldehyde is used in:** 1 - It interacts with urea to produce a kind of **resistant plastic** that is used in the **manufacture of auto parts**, **buttons** and electrical outlets appliances- grease-resistant 2 - Glue industry, which is used to holds the layers of plywood together.
	

 Cinnamaldehyde	 salicylaldehyde	 Benzaldehyde
A kind of **spice**, extracted from the **cinnamon tree** (tropical tree), which has the smell and taste of cinnamon. These trees produce large quantities of cinnamon.	Responsible for the natural **almond flavor**	

Write the short structural formulas for the following:

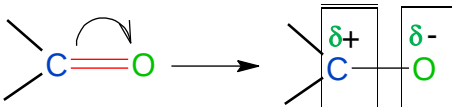
octanal	**hexanal**	**Methanal**
3,3,4-trimethyl hexanal	**3-Ethyl-4- Methyl Heptanal**	**Ethanal**

Name the following aldehydes:

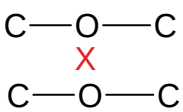
CH_3-$(CH_2)_4$-CHO	$CH_3CH_2CH_2CHO$	CH_3CH_2CHO	CH_3-$(CH_2)_3$- CHO

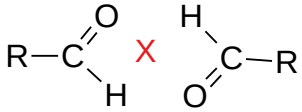
Chemical and physical properties

1 - aldehyde is **polar** and **active**.



2 - **Explain** :**Aldehyde is similar to ethers in not forming hydrogen bonds between them, i.e. both have a low boiling point** : because both do not have a hydrogen atom bonded to oxygen, and therefore hydrogen bonds do not form between molecules.





Explain : **The boiling point of aldehydes is lower than the boiling point of alcohols that contain the same number of carbon atoms** Because alcohol contains the -OH (polar) group, which enables the alcohol molecules to make hydrogen bonds between them, while aldehydes can not make hydrogen bonds between them because they do not contain a hydrogen atom bound to an oxygen atom.

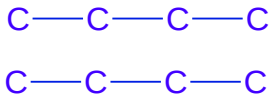
Water solubility of aldehyde :

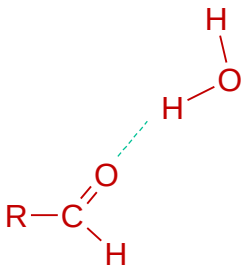
Explain: **(ι) Aldehydes are more soluble in water than alkanes, (ιι) but not to the same degree as alcohols and amines.**

A: (ι) Because aldehyde can form hydrogen bonds with oxygen atoms in water molecules while between alkanes not, but rather weak London dispersion forces.

(ιι) While alcohols and amines have an opportunity to make hydrogen bonds too much with water compared to aldehyde.

(**Note**: Alcohol is often more soluble in water than amines) **Explan**





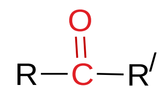
ketones

Ketones : an organic compound where the carbon atom is present in the carbonyl group with two other carbon atoms.

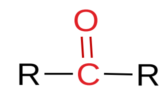
Note: You can have carbonyl balances with many carbon atoms on both ends.

General formula:

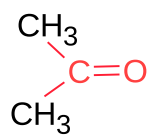
R – CO – R/ / R – CO - R

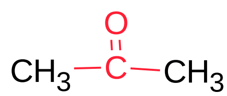


/



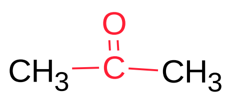
The simplest and most common ketones: **acetone**





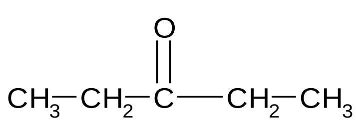
$(CH_3)_2CO$

Naming ketones: The (- one) suffix is added to the name of the alkanes, and a number is placed before the name (of the nearest side of carbonyl group)

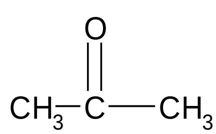


~~2 –~~ Propanone

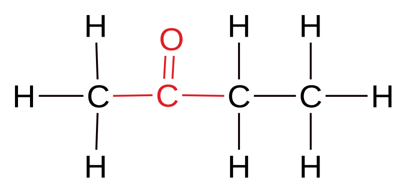
Note: (A number is not placed before the name because the carbonyl group is located only in the middle in this case for the smallest ketone)



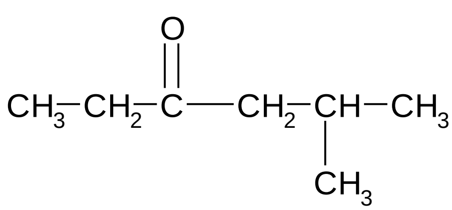
- - - - - - - - - - - - - - - -



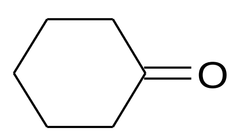
- - - - - - - - - - - - - - -



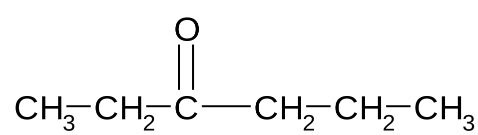
2- Butanone (ethyl methyl ketone)



- - - - - - - - - - - - - - - -



- - - - - - - - - - - - - - - -



- - - - - - - - - - - - - - - -

Write the structural formulas for the following:

3 - Hexanone

- - - - - - - - - - - - - - - -

2- Bantanone

- - - - - - - - - - - - - - - -

2- Octanone

- - - - - - - - - - - - - - - -

3 - methyl-2-hexanone

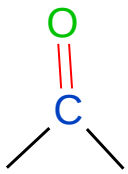
- - - - - - - - - - - - - - - -

cyclohexanone

- - - - - - - - - - - - - - - -

cyclo-pentanone

- - - - - - - - - - - - - - - -



Explain: **Aldehydes and ketones share many chemical and physical properties** due to the similarity of their structure as they both contain a carbonyl group.

Ketones:

1 - Polar molecules 2 - Less active than aldehydes

So ..... ketones are good **solvents for medium polar organic compounds**, including candles, plastic, paints, varnish and glue .

Ketone molecules cannot form a hydrogen bond together, such as aldehyde

But it **can form hydrogen bonds with water molecules**

So ..... **ketones are relatively** soluble in water, **while acetone dissolves in water**