General Chemistry
Theoretical

First stage Students
Department of Physics

Course Instructors
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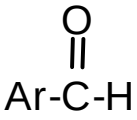
Organic Chemistry

Aldehydes and Ketones

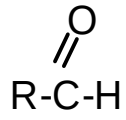
Aldehydes and ketones represent carbonyl compounds, where the functional group is the carbonyl group (C=O).

1. Aldehydes: Aldehydes are characterized by having a hydrogen atom attached to the carbon of the carbonyl group  , which is referred to as the aldehyde group. This group is terminal, and its general formula is:



Ar: An aryl group

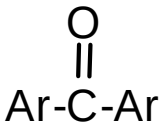
Aromatic aldehyde

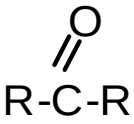


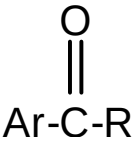
R: An alkyl group

Aliphatic aldehyde

2. Ketones: Ketones contain a carbonyl group located at any position in the molecule except the terminal position. Their general formula is:





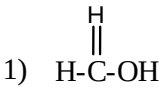


R: An alkyl group

Ar : An aryl group

Nomenclature of Aldehydes and Ketones

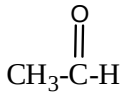
Aldehydes: Aldehydes are named using the corresponding carboxylic acid by replacing the ending "-ic" of the acid name with "aldehyde," as shown in the following examples:

1) 
Formic acid


Formaldehyde

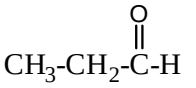
2) CH_3-COOH

Acetic acid

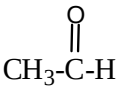

Acetaldehyde

3) CH_3-CH-COOH

Propanoic acid

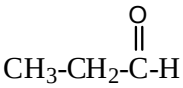

propanaldehyde

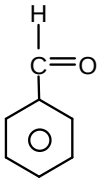
According to the general system, the name of an aldehyde is derived from the original alkane name by adding the suffix "al" to indicate an aldehyde


Ethanol

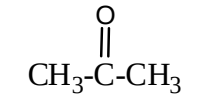
CH_3-CH_2-CH_2 CHO

Butanal


Propanal

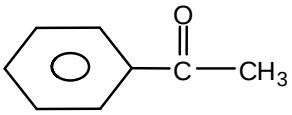

Benzaldehyde

Ketones: The common name of ketones is obtained by naming the groups attached to the carbonyl group followed by the word "ketone," as shown in the examples:

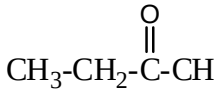


CH_3-C(=O)-CH_3

Dimethyl ketone
(Aceton)



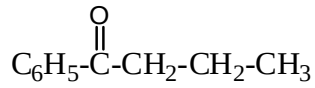
phenyl methyl ketone
(Acetophenone)



CH_3-CH_2-C(=O)-CH

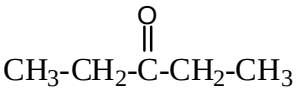
Ethyl methyl ketone
(Butanone)

According to the systematic nomenclature, ketones are named using the original alkane name with the suffix "one" added to the end. If the ketone contains more than four carbon atoms, the carbon atoms are numbered, as in the following examples:



C_6H_5-C(=O)-CH_2-CH_2-CH_3

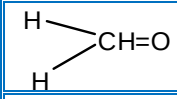
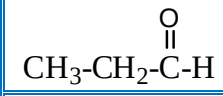
1-phenyl - 1 -Butanone



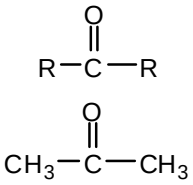
CH_3-CH_2-C(=O)-CH_2-CH_3

3-Pentanone

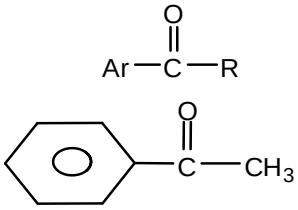
The table below shows some aldehyde and ketone compounds

الصيغة التركيبية	الاسم الدولي	الاسم الشائع
	Methanol	Formaldehyde
	Propanal	Propanaldehyde
$(CH_3)_2-C=O$	Aceton	Dimethyl ketone
$(C_6H_5)_2-C=O$	Diphenylmethanone	Benzophenone

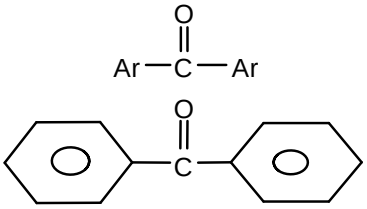
Structures of Ketones



Aceton



Acetophenone

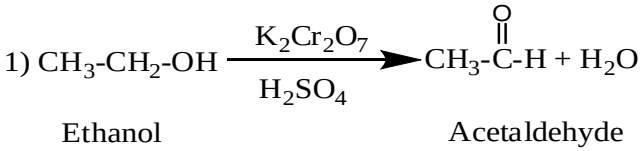


Benzophenone

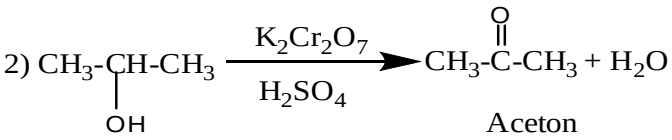
Preparation of Aldehydes and Ketones

1. Oxidation of Alcohols

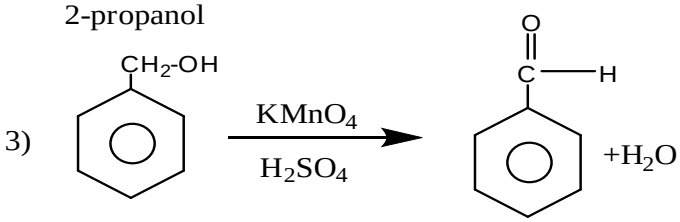
Aldehydes and ketones are prepared by the oxidation of primary and secondary alcohols using an acidified solution of dichromate or potassium permanganate.



Ethanol — Acetaldehyde



2-propanol — Aceton

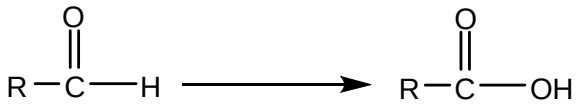


Benzylalcohole
Phenylmethanol — Benzaldehyde

Reactions of Aldehydes and Ketones

1. Oxidation

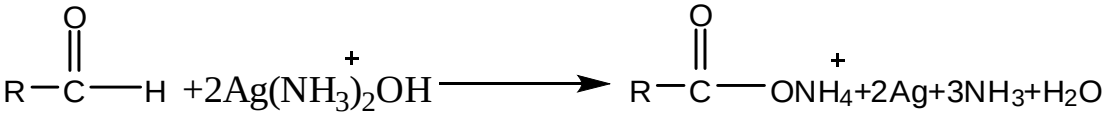
Aldehydes are easily oxidized by all oxidizing agents, including air, to form carboxylic acids.



In contrast, the oxidation of the carbon-carbon bond in ketones is more challenging compared to the carbon-hydrogen bond in aldehydes. As a result, ketones are not easily oxidized.

The distinction between aldehydes and ketones can be made by their reaction with Tollens' reagent (ammoniacal silver nitrate), which is prepared by dissolving silver nitrate in excess ammonium hydroxide.

When Tollens' reagent reacts with aldehydes, free silver is produced, which adheres to the inner walls of the reaction tube, forming a silver mirror.

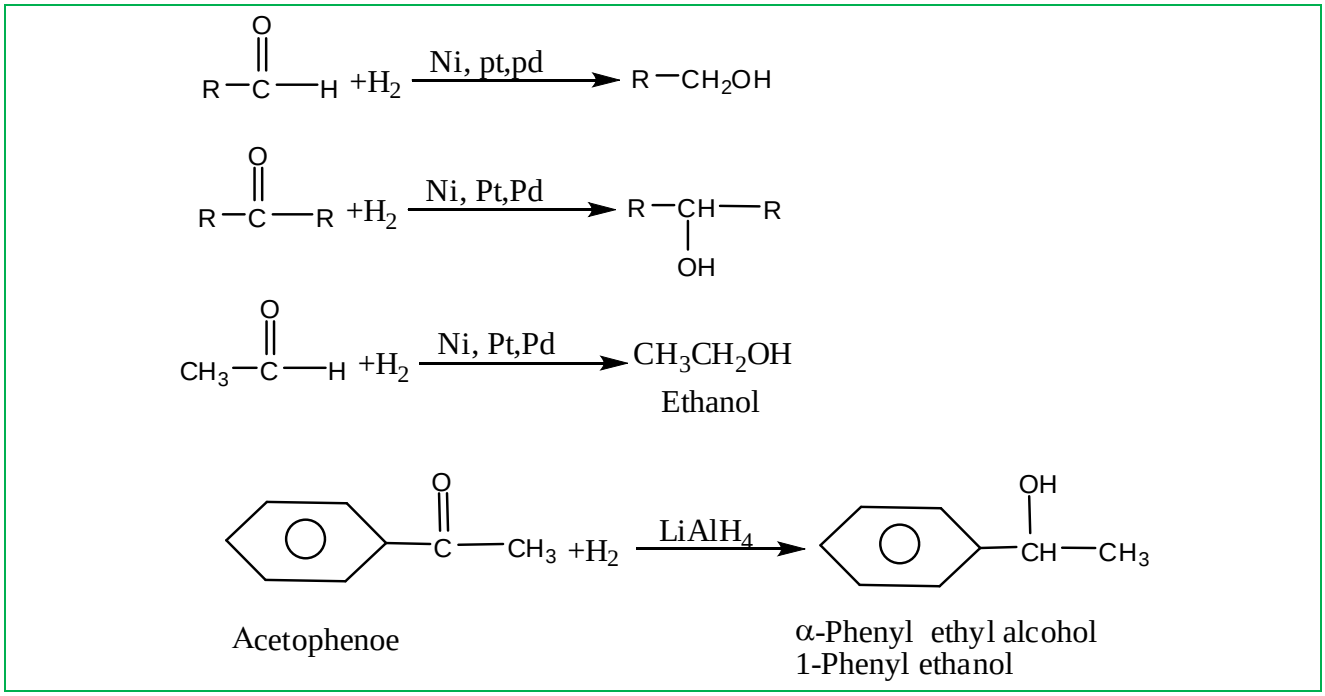


Another test involves using cupric ions (Cu^{2+}) as an oxidizing agent in Fehling's solution in the presence of a salt.

2. Reduction

Reduction to Alcohols

Aldehydes are reduced to primary alcohols, while ketones are reduced to secondary alcohols. Reduction involves the addition of hydrogen to the carbonyl group in the presence of a catalyst.



Reduction of aldehydes to primary alcohols:
Aldehyde → Primary alcohol
Ketone → Secondary alcoho