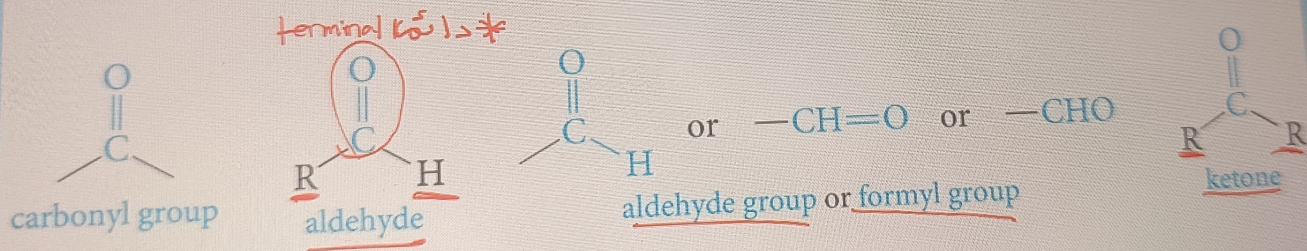


Aldehydes and ketones are characterized by the presence of the carbonyl group, which is perhaps the most important functional group in organic chemistry. Aldehydes have at least one hydrogen atom attached to the carbonyl carbon atom. The remaining group may be another hydrogen atom or any aliphatic or aromatic group. The $-CH=O$ group characteristic of aldehydes is often called a formyl group. In ketones, the carbonyl carbon atom is connected to two other carbon atoms



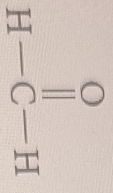
Nomenclature;

In the IUPAC system, the characteristic ending for aldehydes is al from the first syllable of aldehyde)

* Common names

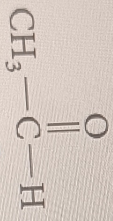
أبداً

1. أبداً $C=O$ أبداً H



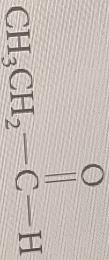
methanal

formaldehyde



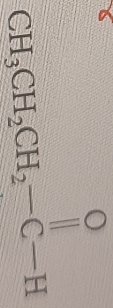
ethanal

acetaldehyde



propanal

(propionaldehyde)



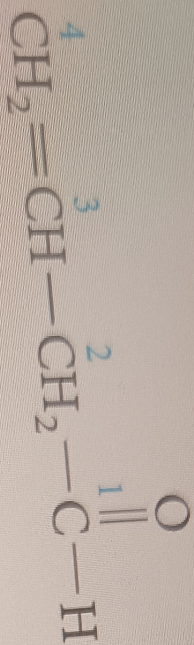
butanal

(n-butyraldehyde)

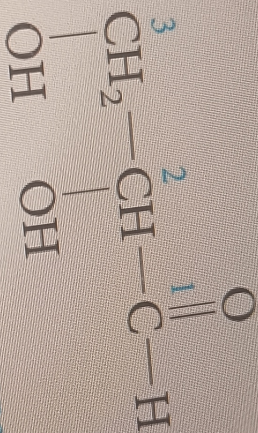
أبداً acet

أبداً buty

أبداً form



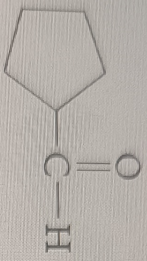
3-Butenal



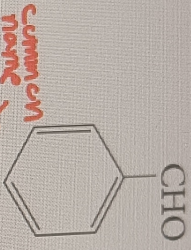
2,3-dihydroxypropanal

glyceraldehyde

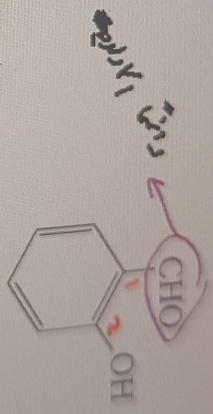
For cyclic aldehydes the suffix -carbaldehyde is used. Most of the aromatic aldehydes have common names.



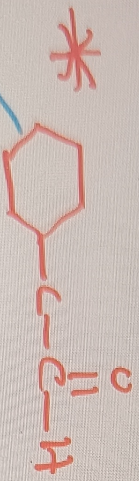
cyclopentanecarbaldehyde
(formylcyclopentane)



benzaldehyde
(benzenecarbaldehyde)
IUPAC



salicylaldehyde
(2-hydroxybenzenecarbaldehyde)

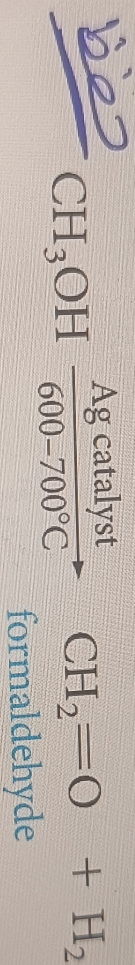


cyclohexyl ethanal

→ cyclohexane ring is a six-membered ring.
→ cyclohexyl ethanal is a six-membered ring with a -CH2-CHO group attached to one of the carbons.

Some Common Aldehydes and Ketones

Formaldehyde, which is the simplest aldehyde, is manufactured by the catalytic oxidation of methanol. The annual world production is more than 46 billion pounds.



Formation of aldehydes and ketones

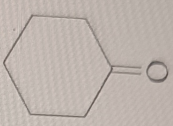
1. Oxidation of alcohols

- For aldehydes: oxidation of primary alcohols
- For ketones: oxidation of secondary alcohols

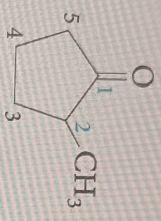
2. Acylation of benzene

3. Ozonolysis of alkenes

4. Hydrolysis of alkynes (mostly forms ketones, only ethyne forms aldehyde)



cyclohexanone



2-methylcyclopentanone

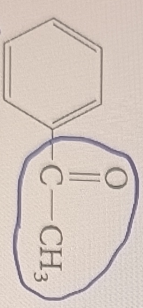
3-oxo pentanal
C-C-C-C-C=O

صحة الكاربون

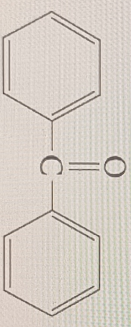


3-buten-2-one
(methyl vinyl ketone)

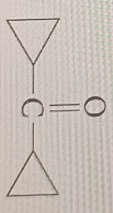
acetyl group



acetophenone
(methyl phenyl ketone)



benzophenone
(diphenyl ketone)



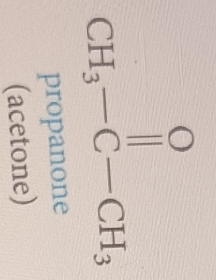
dicyclopropyl ketone

صحة

صحة

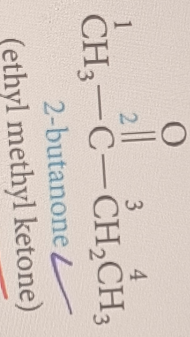
* The ending of ketones is -one (from the the last syllable of ketone). The chain is numbered so that the carbonyl carbon has the lowest possible number.

* isn't terminal

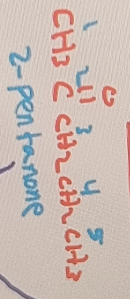
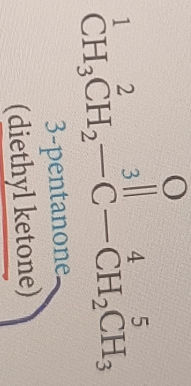


dimethyl ketone
methyl ketone

* Symmetrical ketone so methyl ketone is correct.

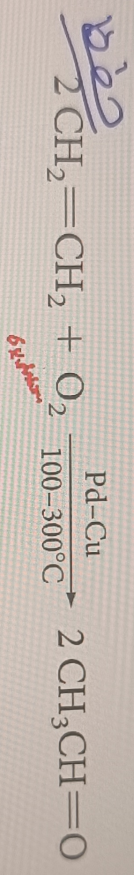


butanone
عبد الفتاح واحد
مقابل

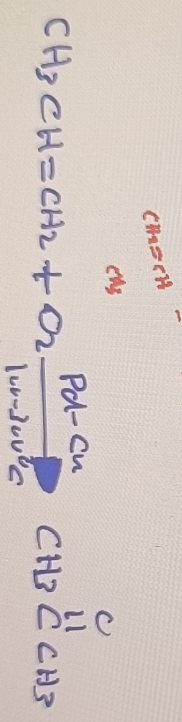


* Structural isomers

Acetaldehyde ($\text{CH}_3\text{CH}=\text{O}$) is manufactured mainly by the oxidation of ethylene over palladium-copper catalyst. About 1 billion pounds are produced each year.

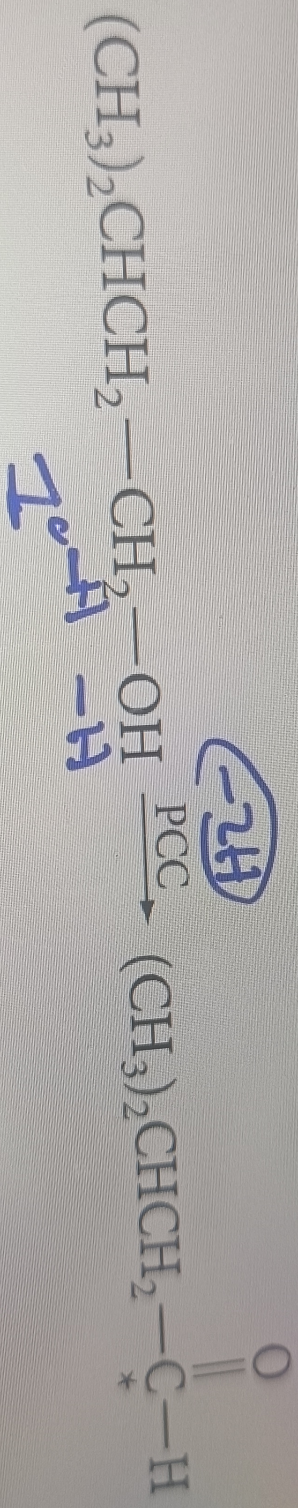


Acetone, the simplest ketone may be prepared using a similar method from the oxidation of propene.

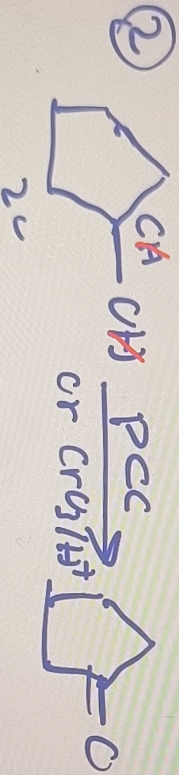
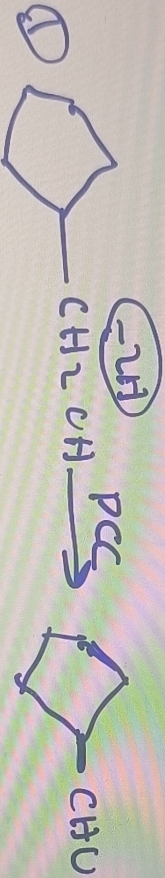
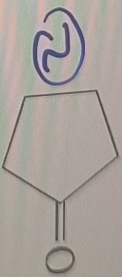
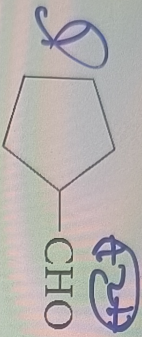


Aldehydes and ketones are mostly prepared by the oxidation of primary and secondary alcohols respectively. Chromium reagents such as pyridinium chlorochromate (PCC), are commonly used in the laboratory.

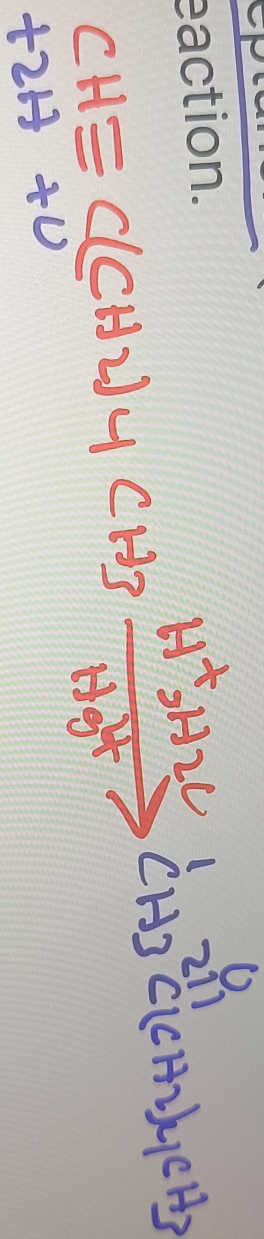
example



Using an appropriate alcohol, write an equation to show how the following compounds can be made by oxidation.

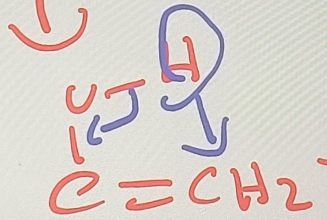
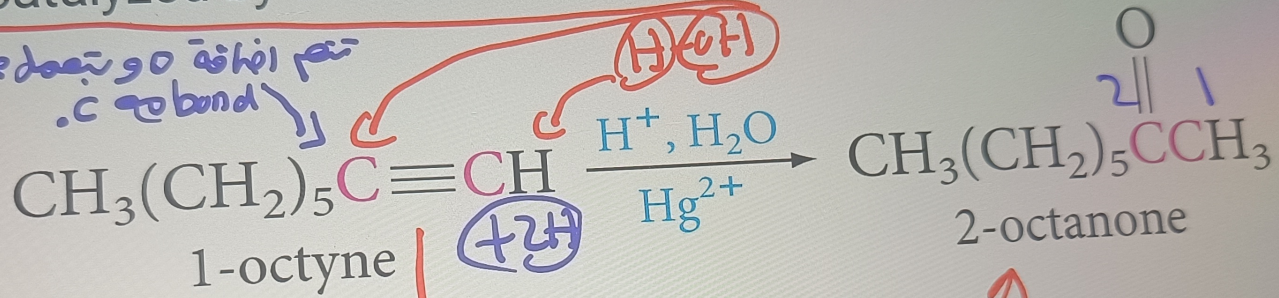


What alkyne would be useful for the synthesis of 2-heptanone (oil of cloves)? Write the synthesis reaction.



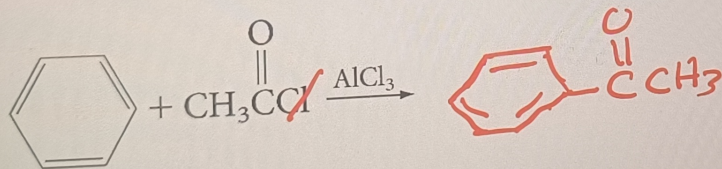
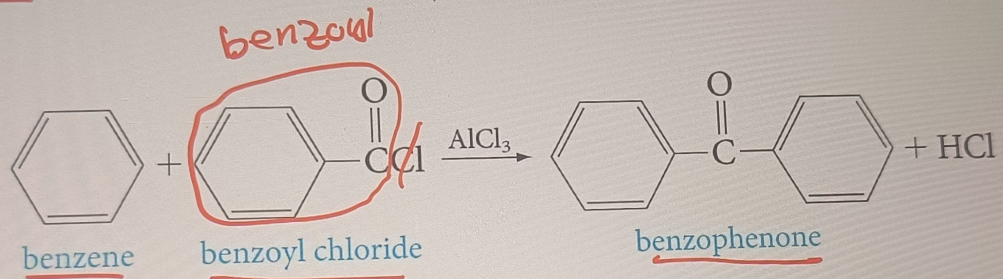
Methyl ketones can be prepared by the hydration of terminal alkynes, catalyzed by acid and mercury ion.

double bond go ashil per .c bond

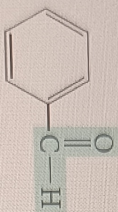


Enol

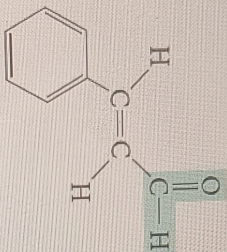
Aromatic ketones can be prepared by Friedel-Crafts acylation of an aromatic ring



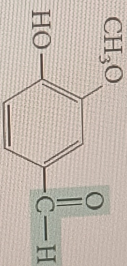
Aldehydes and Ketones in Nature

bio

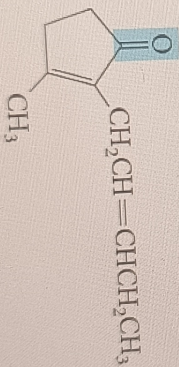
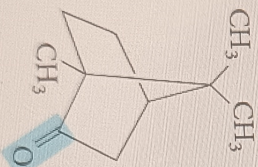
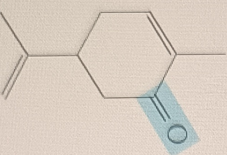
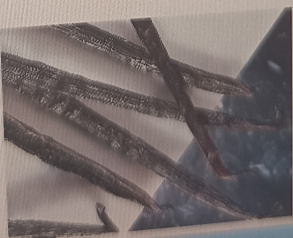
benzaldehyde
(oil of almonds)
bp 178.1°C



cinnamaldehyde
(cinnamon)
bp 253°C

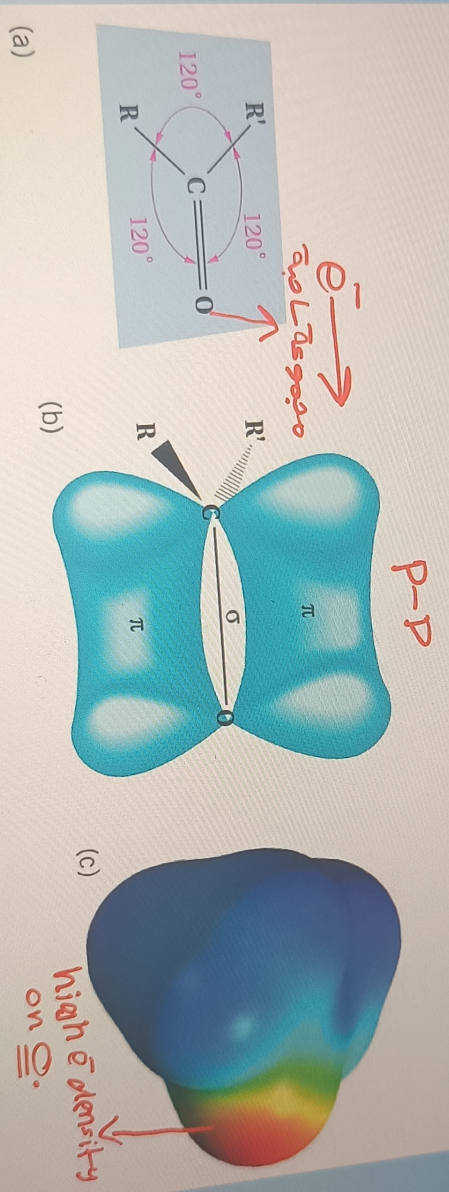


vanillin
(vanilla bean)
mp 80°C; bp 285°C

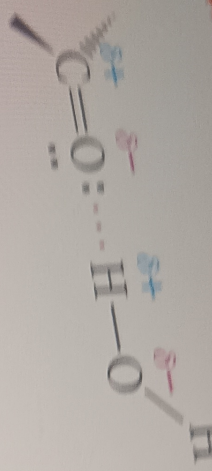


jasmonone

Nu^-
 attack here by a Nu^-
nucleophile
 δ^+ δ^-
 $\text{C}=\text{O}$
reba
 nucleophilic addition
 may react
 with a proton



هذا يدل على أن
تقليل قابلية التفاعل

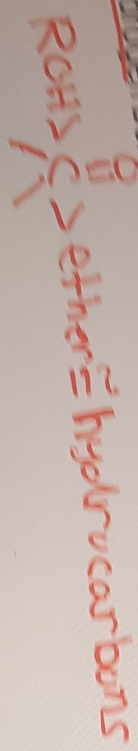


Aldehydes and ketones that have a C=O bond, but no O-H bond, cannot form

hydrogen bonds with one another, as alcohols. Aldehyde and ketones therefore have relatively higher boiling points than

hydrocarbons, but less than alcohols. Aldehyde and ketones are water soluble as they can

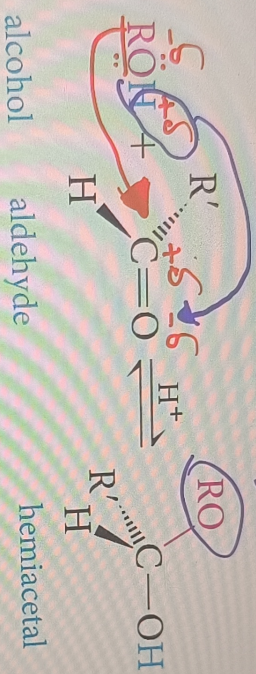
form hydrogen bonds with the water molecules but not with themselves.



Addition of Alcohols: Formation of Hemiacetals and Acetals

Nucleophilic addition

grad 1.V

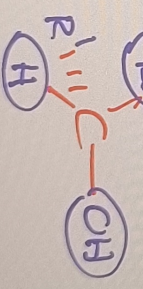


Alcohols are oxygen nucleophiles, they add to the C=O bond, the OR group becoming attached to the carbon and the proton becoming attached to the oxygen.

The product is a hemiacetal which contains both alcohol and ether groups on the same carbon.

The addition process is reversible

hemiacetal carbon



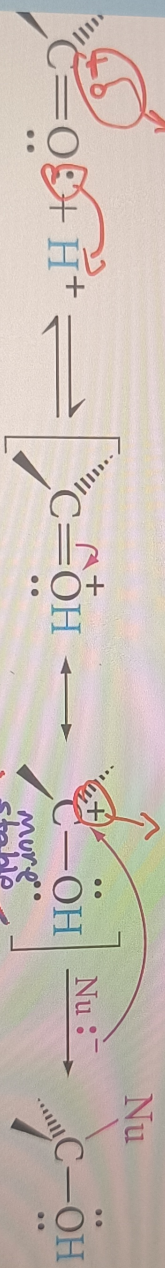
تسرع

Acids can catalyze the addition of weak nucleophiles to carbonyl compounds by protonating the carbonyl oxygen atom. This makes the carbonyl carbon more electrophilic and reactive by converting it to a carbocation thereby enhancing its susceptibility to attack by nucleophiles.

قابلية

partial positive

Fully positive



a resonance-stabilized carbocation

more stable

more stable

وهو اقل على electronegativity لالارجبه electronegativity اقل

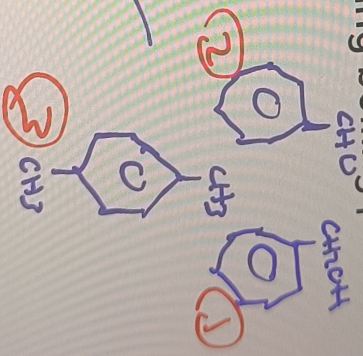
وهو اقل على electronegativity لالارجبه electronegativity اقل

Classification of Nucleophiles:

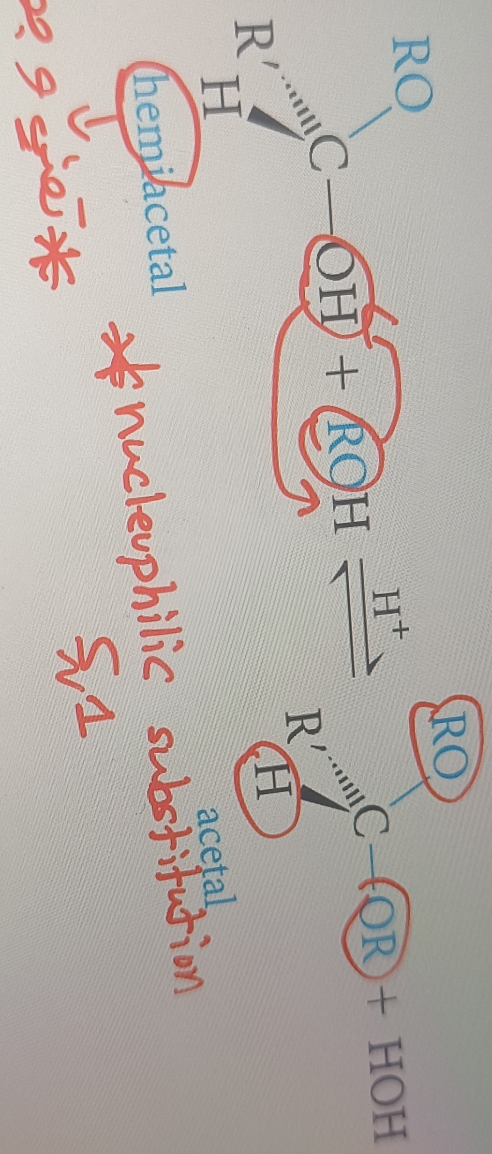
Clicker Question

Arrange Benzaldehyde (MW=106), Benzyl alcohol (MW=108) and p-Xylene (MW=106) in order of increasing boiling point?

- A. Benzaldehyde < Benzyl alcohol < p-Xylene
- B. Benzyl alcohol < Benzaldehyde < p-Xylene
- C. p-Xylene < Benzaldehyde < Benzyl alcohol
- D. p-Xylene < Benzyl alcohol < Benzaldehyde



In the presence of excess alcohol, hemiacetals react to form acetals. acetals have two ether functional groups at the same carbon atom.



aldehyde or ketone

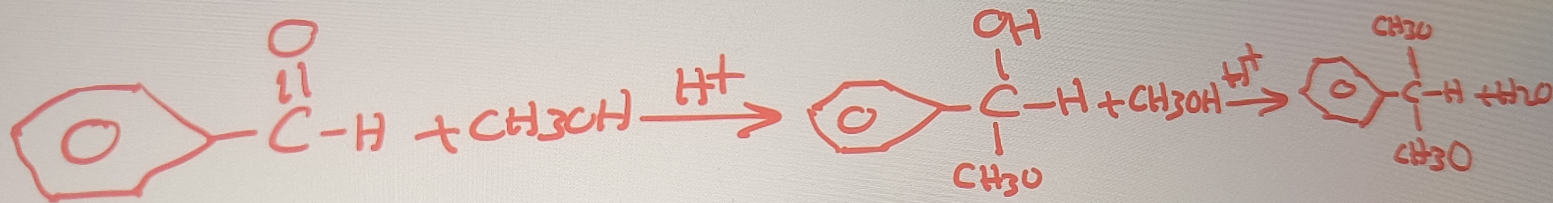
R'' hemiketal

R''

acetal

Question

Write the equation for the reaction of benzaldehyde with excess methanol and an acid catalyst.



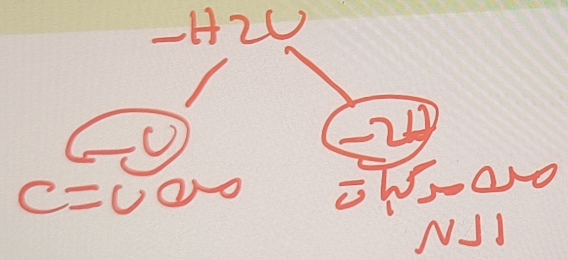
27



... reaction if acetal hydrolysis. This is achieved by

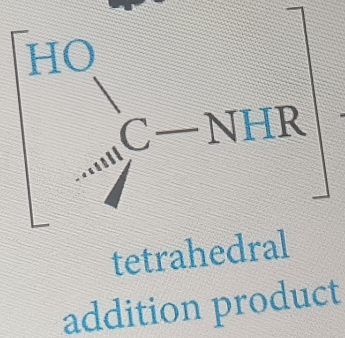
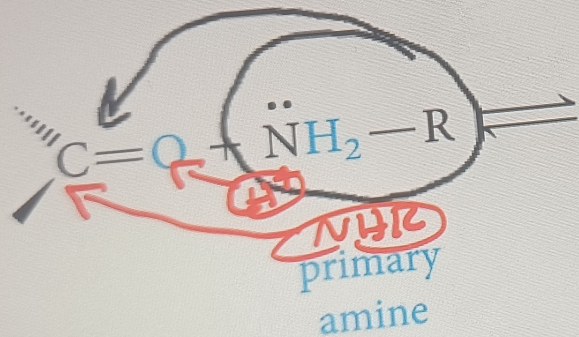
Table 3.1 Nitrogen Derivatives of Carbonyl Compounds

Formula of ammonia derivative	Name	Formula of carbonyl derivative	Name
RNH_2 or ArNH_2	primary amine	$\text{C}=\text{NR}$ or $\text{C}=\text{NAr}$	imine
NH_2OH	hydroxylamine	$\text{C}=\text{NOH}$	oxime
NH_2NH_2	hydrazine	$\text{C}=\text{NNH}_2$	hydrazone
$\text{NH}_2\text{NHC}_6\text{H}_5$	phenylhydrazine	$\text{C}=\text{NNHC}_6\text{H}_5$	phenylhydrazone



Addition of Nitrogen Nucleophiles

nucleophilic addition



elimination

-HOH

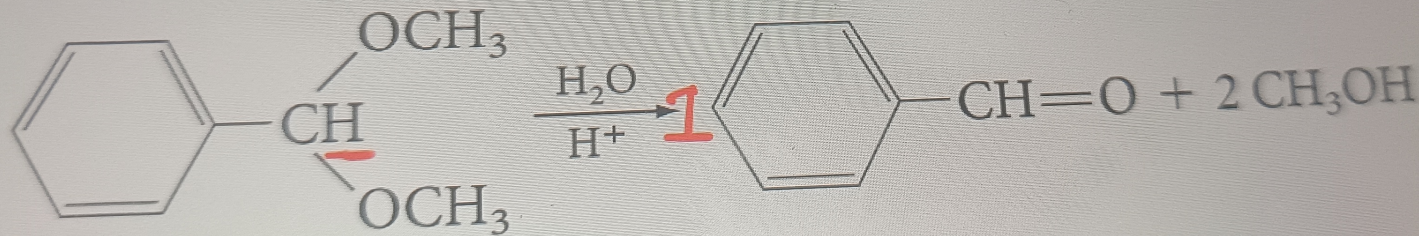
imine
nucleophilic substitution

net → substitution

*

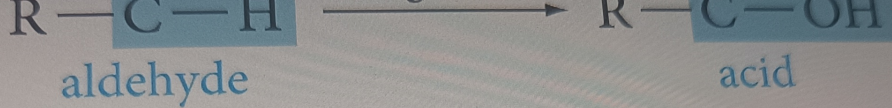
The reverse of acetal formation is acetal hydrolysis. This is achieved by excess water in the presence of an acid catalyst.

hydrolysis/elimination \leftarrow saturated \rightarrow unsaturated



acetal

benzyl \rightarrow salt

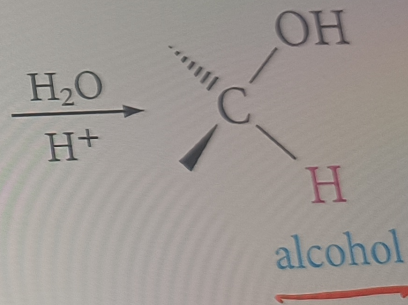
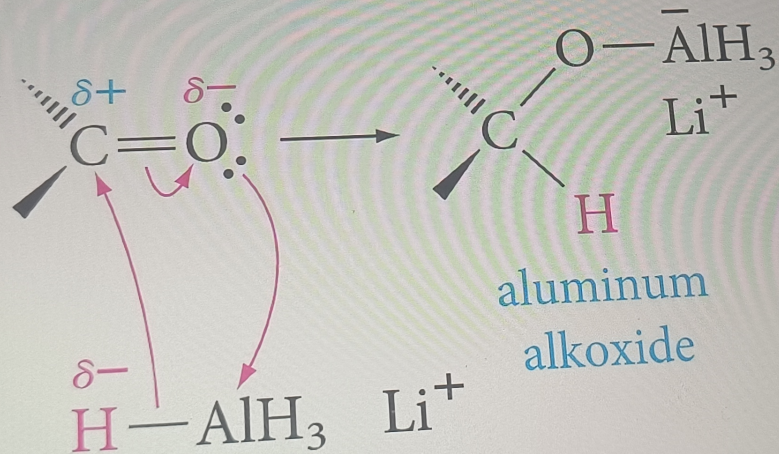
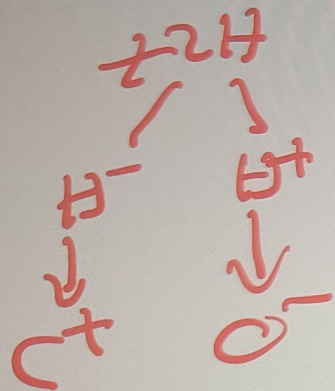


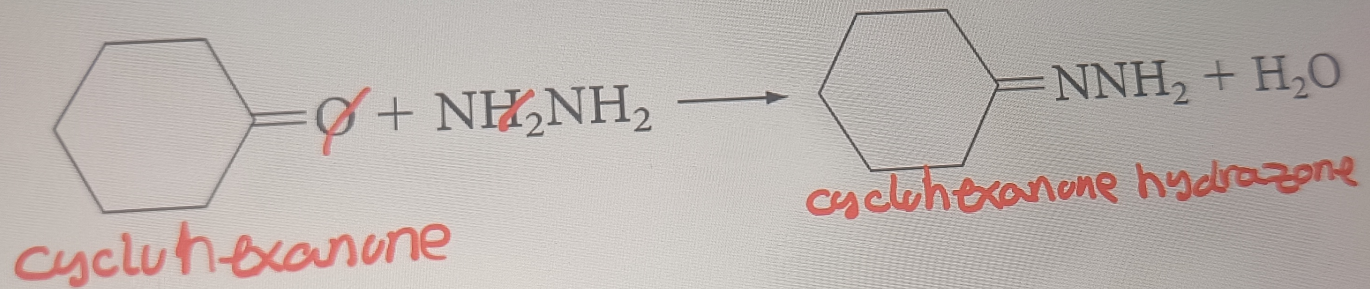
Oxidation may be achieved by many oxidizing agents, such as KMnO_4 , CrO_3 , Ag_2O , and peracids.

①, ②, ③, ④ → strong oxidizing agents

Reduction of Carbonyl Compounds

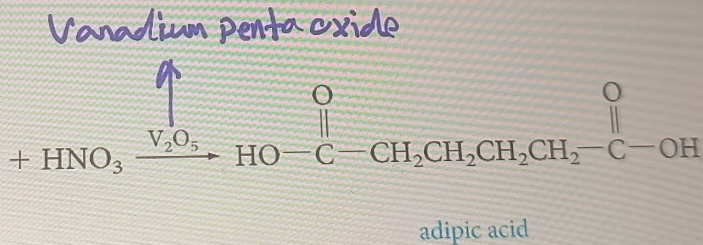
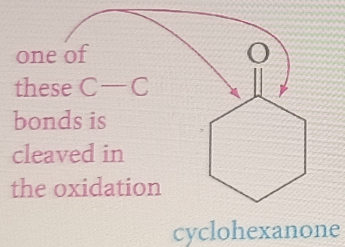
addition and reduction



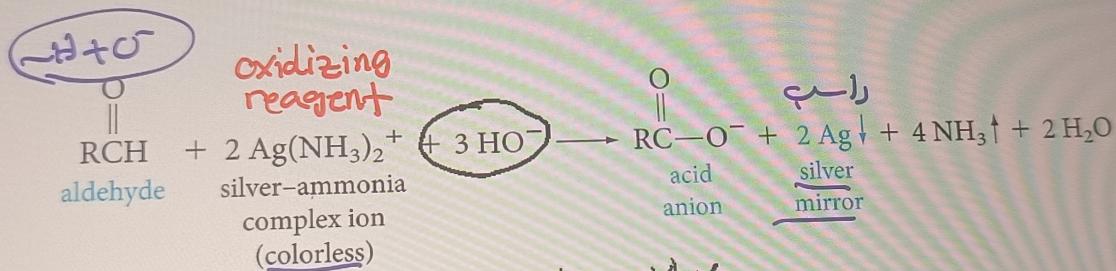


Ketones also can be oxidized, but require special oxidizing conditions.

سبب*
cyclohexanone سبب

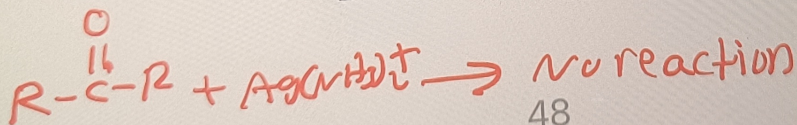


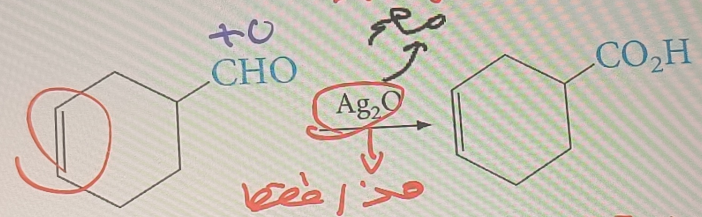
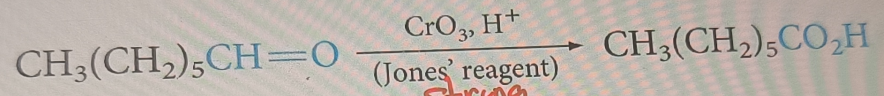
Silver ion as an oxidizing agent is expensive but has the virtue that it selectively oxidizes aldehydes to carboxylic acids in the presence of alkenes. A laboratory test that distinguishes aldehydes from ketones takes advantage of their different ease of oxidation. In the Tollen's silver mirror test, the silver-ammonia complex ion is reduced by aldehydes (but not ketones) to metallic silver according to the equation below.



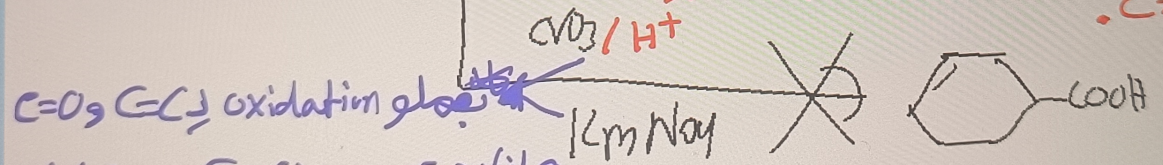
↳ can distinguish

between aldehyde and ketone





* لیکن استفادہ پیس وجود C=C



تجملو oxidation ل C=C و C=O
وانا بدی بس C=O یعدی لها
اکسده لیس صض کر بوکسلیر

