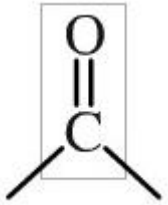
Aldehydes and Ketones

Chapter 1.5

The Carbonyl Group

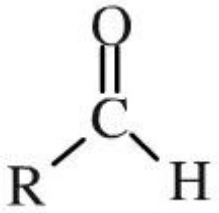
- Aldehydes and ketones both contain the carbonyl group
- A **carbonyl group** is a carbon atom double bonded to an oxygen atom



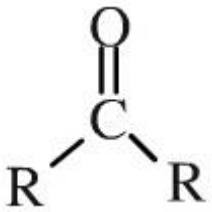
- The difference between aldehydes and ketones is the location of the carbonyl group

Aldehydes and Ketones

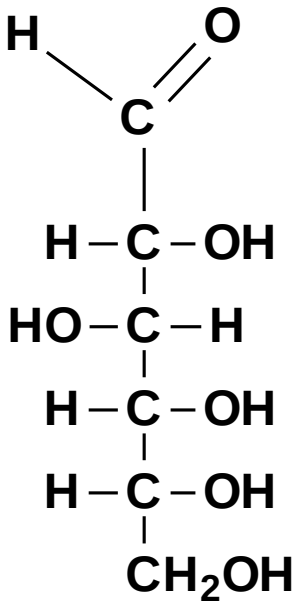
- An **aldehyde** is an organic molecule containing a carbonyl group that is bonded to at least one hydrogen atom



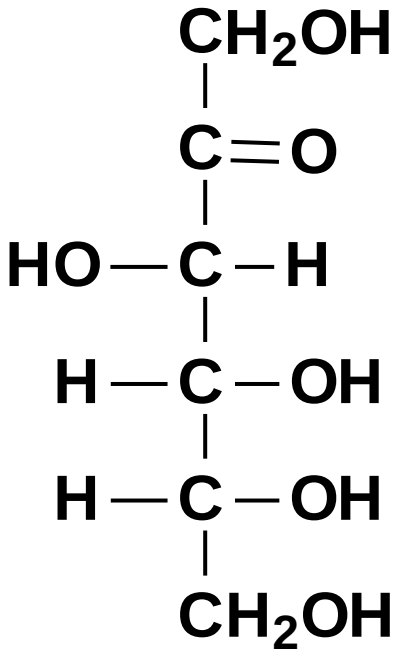
- A **ketone** is an organic compound that contains a carbonyl group bonded to two carbon atoms



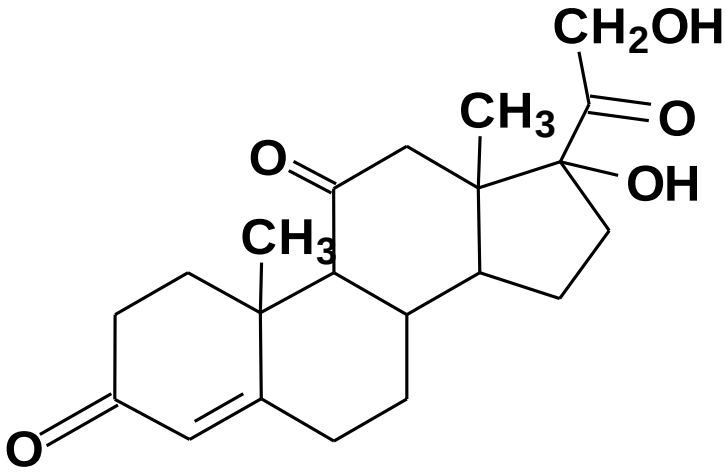
Aldehyde or Ketone?



glucose



D-Fructose

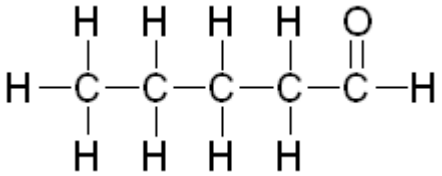


Cortisone

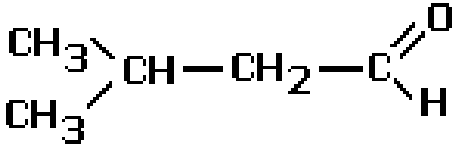
Naming Aldehydes

- Use the suffix *–al*
- Always number the parent chain so that the carbonyl group is on carbon 1

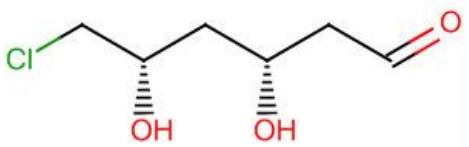
a)



b)

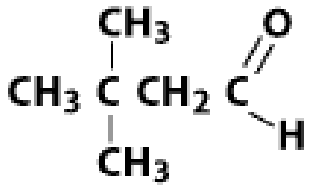


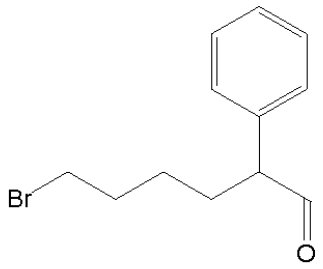
c)



Practice

1) Name the following aldehydes:

a) 

b) 

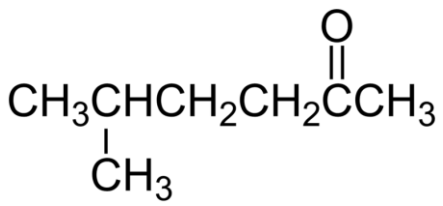
2) Draw structural diagrams for the following aldehydes:

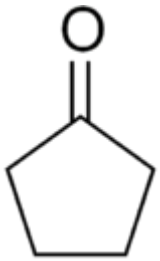
a) 3-methylpentanal

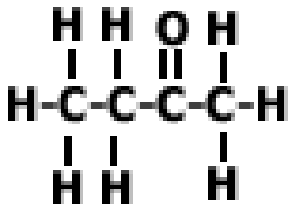
b)2,3-dichloropropanal

Naming Ketones

- Use the suffix *–one*
- Number the parent chain so that the carbonyl group has the lowest number possible
- It may be necessary to use a number to indicate the position of the carbonyl group

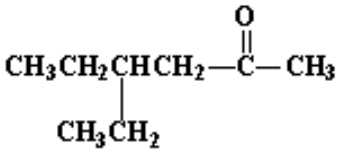
a) 

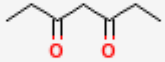
b) 

c) 

Practice

1) Name the following ketones:

a) 

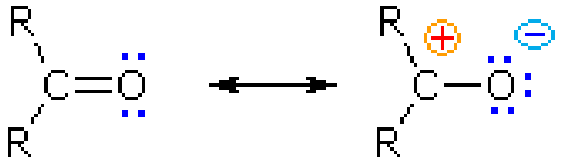
b) 

2) Draw structural diagrams for the following ketones:

a) 3-methylbutanone b)cyclohexanone

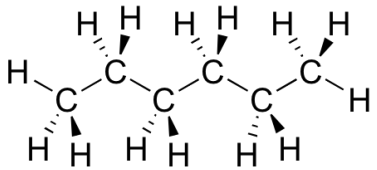
Properties of Aldehydes and Ketones

- Oxygen has a much higher electronegativity than carbon
- Electrons from the double bond are attracted to the oxygen atom
- Thus carbonyl containing compounds are polar

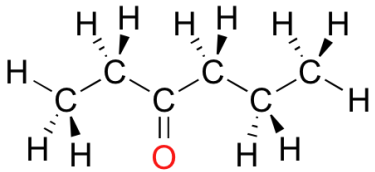


Properties of Aldehydes and Ketones

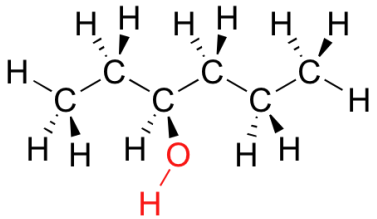
- The dipole-dipole interactions give aldehydes and ketones higher melting and boiling points than their corresponding alkanes
- Aldehydes and ketones lack the ability to hydrogen bond to each other so their melting and boiling points are lower than their corresponding alcohols



hexane
bp = 69°C



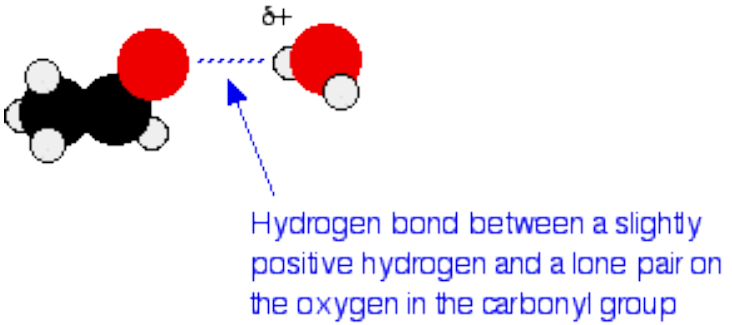
3-hexanone
bp = 123 °C



3-hexanol
bp =135°C

Properties of Aldehydes and Ketones

- Since aldehydes and ketones are polar, they will dissolve in water



- Small aldehydes and ketones are completely soluble in water, but the solubility decreases as additional cabons are added to the chain

Reactions Involving Aldehydes and Ketones

Preparing Aldehydes and Ketones

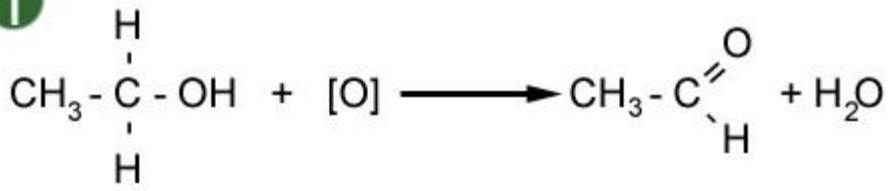
- Aldehydes and ketones are synthesized by the **controlled oxidation** of alcohols
- Controlled oxidation reactions use **oxidizing agents** such as potassium dichromate (K_2Cr_2O), hydrogen peroxide (H_2O_2), and potassium permanganate ($KMnO_4$) to supply the oxygen
- For simplicity, we will use the symbol (O) to represent an oxidizing agent

Reactions Involving Aldehydes and Ketones

Preparing Aldehydes and Ketones

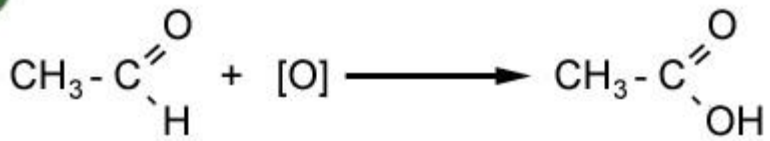
- A **primary alcohol** is first oxidized to produce an **aldehyde** and water
- The aldehyde can then be further oxidized to produce a **carboxylic acid** *(we will learn about carboxylic acids later)*

1



ethanol ethanal

2

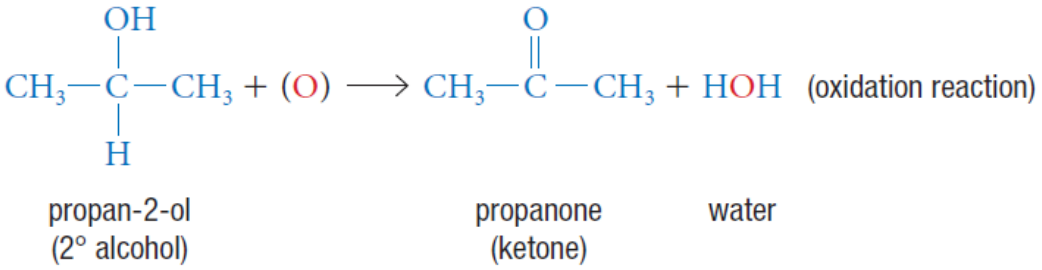


ethanal ethanoic acid

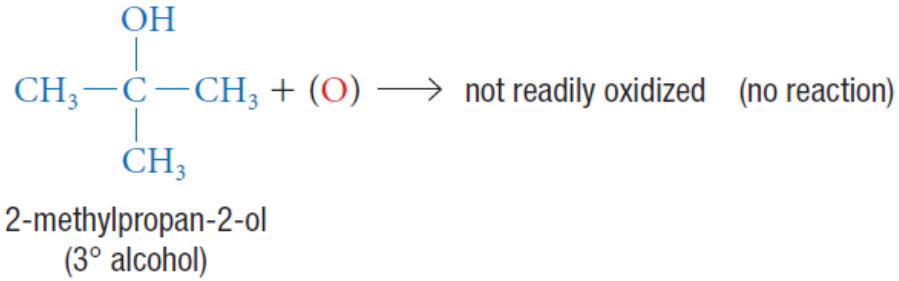
Reactions Involving Aldehydes and Ketones

Preparing Aldehydes and Ketones

- A **secondary alcohol** is oxidized to produce a **ketone** and water



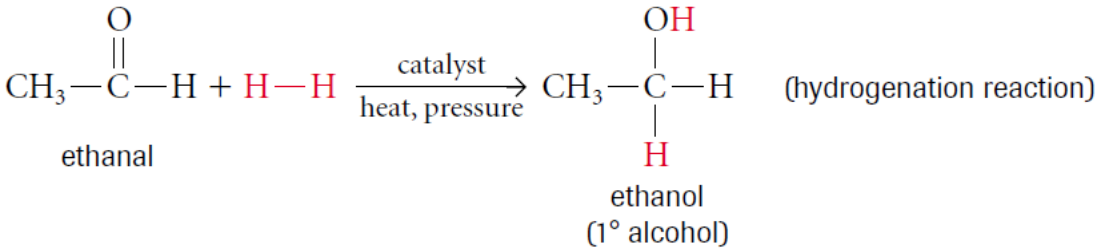
- **Tertiary alcohols** do not undergo oxidation reactions



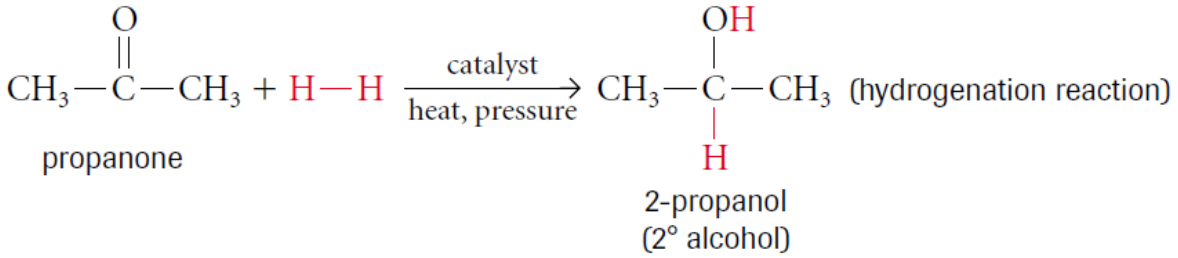
Reactions Involving Aldehydes and Ketones

1) Combustion
2) Addition – Hydrogenation

- Aldehydes undergo **hydrogenation** to produce primary alcohols



- Ketones undergo **hydrogenation** to produce secondary alcohols



HOMEWORK

Required Reading:

p. 40-46

Questions:

p. 41 #1-2

p. 42 #1-2

p. 43 #1-3

p. 46 #1-5