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Subject: P'ceutical Organic Chemistry-1

Subject Code: BP-202T

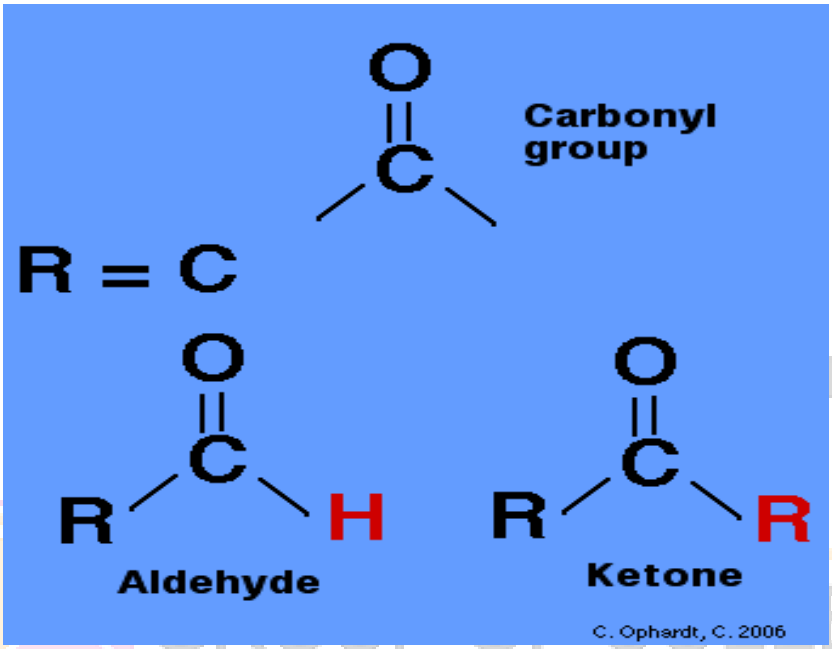
Unit: IVth

Topic: Method of Preparation of Carbonyl Compounds

Lecture: 28/03/2020

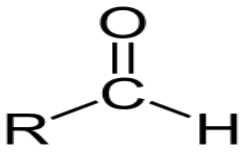
Carbonyl Compounds

Carbonyl compounds are molecules containing the carbonyl group. Aldehydes and Ketones are simple organic compounds containing a carbonyl group. Carbonyl group contains carbon-oxygen double bond. These organic compounds are simple because the carbon atom presents in the carbonyl group lack reactive groups such as OH or Cl.

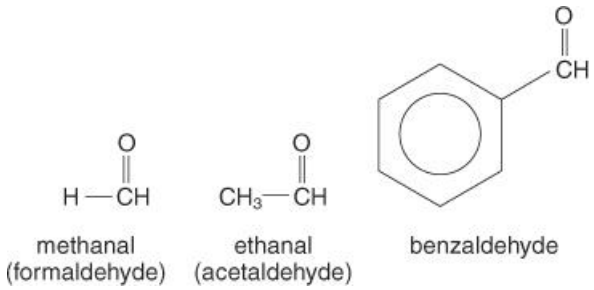


Aldehydes

An aldehyde is one of the classes of carbonyl group-containing alkyl group on one end and hydrogen on the other end. The R and Ar denote alkyl or aryl member respectively. In the condensed form, the aldehyde is written as –CHO.

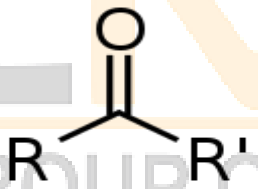


Structure of Aldehydes

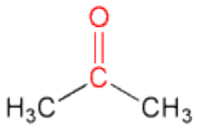


Ketones

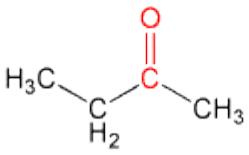
Ketone is a member of the carbonyl group-containing alkyl or aryl group on both the end of the carbonyl group. The compound formula is RC(=O)R'. In this case, R and R' are the different carbon containing substituents.



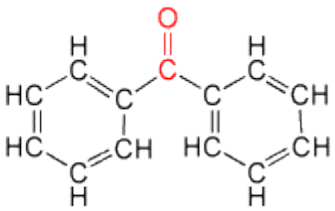
Structures Of ketones



- acetone
- dimethyl ketone
- 2-propanone



- methyl ethyl ketone
- MEK
- 2-butanone



- benzophenone
- diphenyl ketone

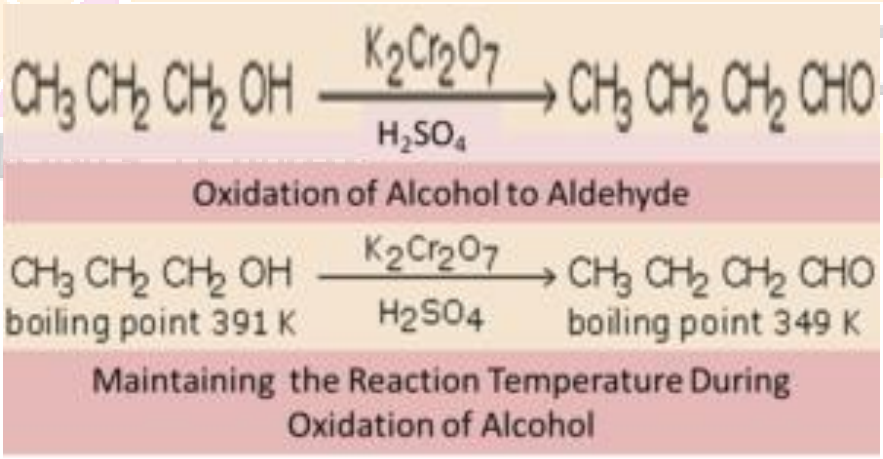
Method of Preparation of Aldehydes and Ketones

Aldehydes and Ketones can be prepared by following methods.

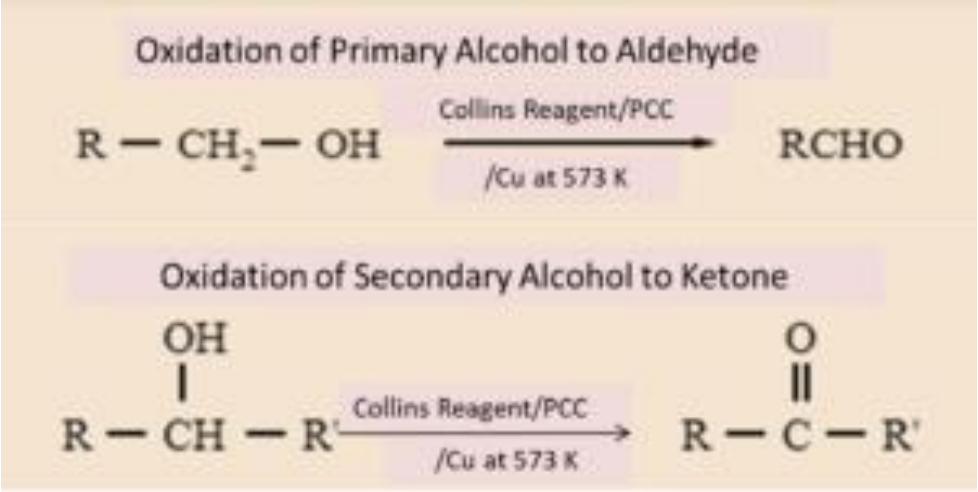
1. By Oxidation of Alcohols

Oxidation of primary and secondary alcohols leads to the formation of aldehydes and ketones. The oxidation is possible with the help of common oxidizing agents are $KMnO_4$, $K_2Cr_2O_7$, and CrO_3. Strong oxidizing agents helps in the oxidation of the primary alcohol to aldehyde then to a carboxylic acid.

Primary alcohols having low molecular weight can undergo oxidation and form aldehydes. The reaction mixture after aldehyde formation can avoid further oxidation if the reaction temperature is modulated so that the boiling point of the aldehyde is lower than the alcohol which helps in the distillation of aldehyde from the reaction mixture soon after its formation. Hence, it is important to maintain the reaction temperature slightly more than 349K. Refer to the reaction below



Aldehyde and Ketone preparation is possible by oxidation of primary and secondary alcohol by agents such as *PCC (pyridinium chlorochromate), Collins reagents (Chromium trioxide-pyridine complex)*, and Cu at 573 K.

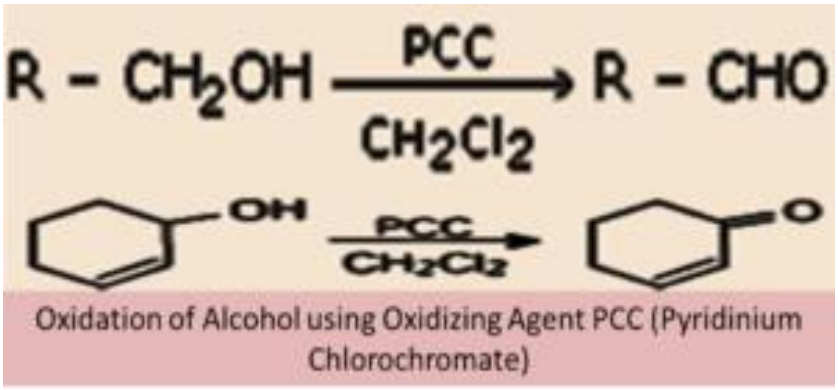


Collins Reagents (Chromium trioxide-pyridine complex)

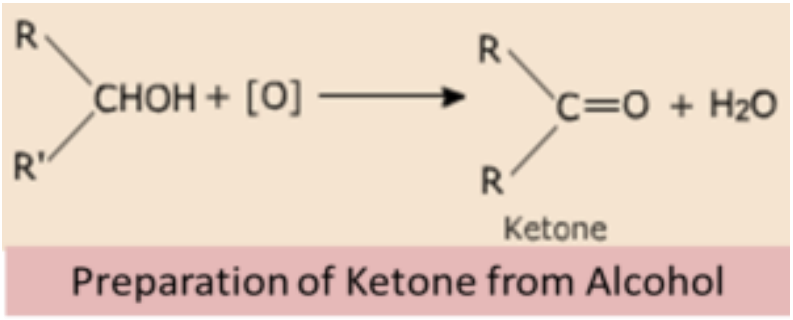
Collin's reagent or chromium trioxide-pyridine complex is a good oxidizing reagent for conversion of primary alcohol to aldehydes. Additionally, an advantage of Collins reagent is that it helps to cease further oxidation of aldehydes to carboxylic acids. However, the reaction with Collins reagent is possible in a non-aqueous medium such as CH_2Cl_2.

PCC (pyridinium chlorochromate)

The mixture of pyridine along with CrO_3 and HCl in dichloromethane leads to the formation of Pyridine chlorochromate or PCC ($C_5H_5NH^+CrO_3\ Cl^-$).



Ketones can be prepared by using similar oxidizing agents from secondary alcohols.



Preparation of Ketone from Alcohol

2. By Ozonolysis Of Alkenes

Formation of aldehyde and ketone is possible by ozonolysis of alkenes. Ozonolysis is a reaction method in which addition of ozone molecules or O_3 to an alkene compound leads to the formation of ozonide. Reduction of the ozonide compound with the help of zinc dust and water produces the smaller molecules, which in this case will be the respective aldehydes and ketones. The reaction produces aldehydes, ketones and in some cases both the compounds on the basis of the substitution arrangement of the alkene compounds.

$$\underset{\text{Alkene}}{R-CH=CH-R} \xrightarrow[(ii)H_2O/Zn]{(i)O_3} R-CHO + RCHO$$