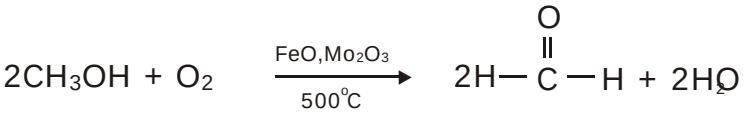
Chemistry Part II Chapter#12 (Aldehydes and Ketones)
SHORT QUESTIONS

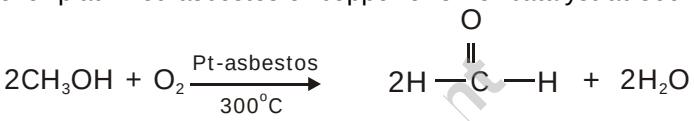
1. Describe preparation of formalin from methanol on commercial scale.

Ans: Industrial (Commercial) Method:
Formaldehyde (Formalin) is manufactured commercially by passing a mixture of methanol vapours and air over iron oxide-molybdenum oxide or silver catalyst at 500°C.



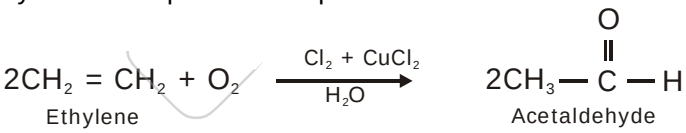
2. Explain one method of formation of formaldehyde from methyl alcohol.

Ans: Formaldehyde is prepared in the laboratory by passing a mixture of methyl alcohol vapours and air over platinized asbestos or copper or silver catalyst at 300°C.



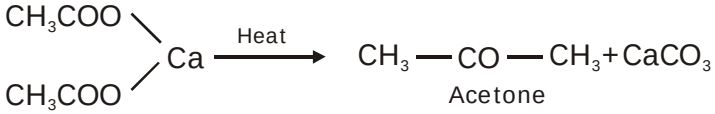
3. Write a method for the commercial preparation of acetaldehyde?

Ans: Industrial Method:
Acetaldehyde is prepared industrially by oxidation of ethylene in air using palladium chloride catalyst with a cupric chloride promoter.



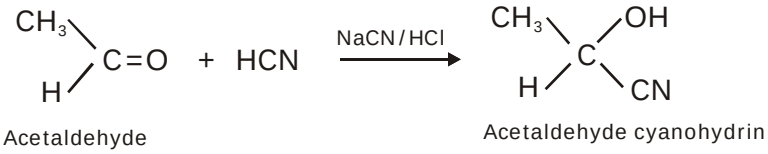
4. Convert calcium acetate to acetone.

Ans: Calcium acetate is converted to acetone when its dry distillation is done.

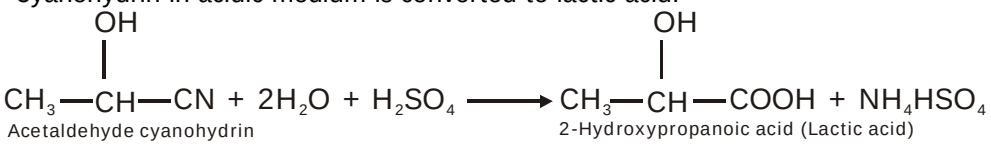


5. Convert acetaldehyde into lactic acid.

Ans: Acetaldehyde is reacted with hydrogen cyanide to produce acetaldehyde cyanohydrin.



Cyanohydrin in acidic medium is converted to lactic acid.



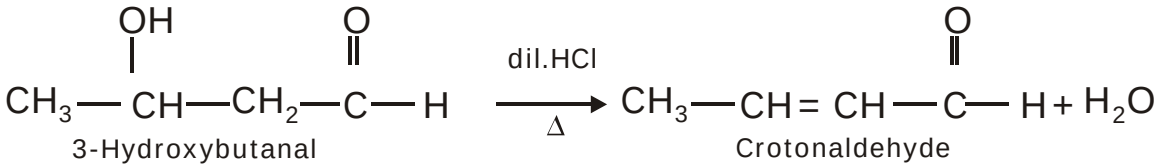
6. For Aldol condensation the presence of ~Jhydrogen is must in aldehydes and ketones. Give reasons.

Ans: Aldol condensation proceeds through the formation of carbanion in the first step. This ion is produced when the acidic hydrogen at the α–carbon is removed by the base (OH^-). In the absence of α–hydrogen, carbanion cannot be produced, so aldol condensation cannot take place.

7. How is crotonaldehyde obtained from Aldol?

Ans: Conversion of Aldol to Croton aldehyde:

The aldol undergoes dehydration on heating in the presence of dilute acid to form α,β-unsaturated carbonyl compound. A carbon-carbon double bond is formed between the α- and β-carbon atoms.



8. What are disproportionation reactions?

Ans: It is a disproportionation (self oxidation-reduction) reaction. The molecules being oxidized and reduced are the same chemical species.

Example:

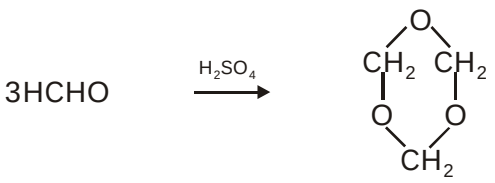
9. Justify that Cannizaro's reaction is a self redox reaction.

Ans: In Cannizaro's reaction, one of the molecules of aldehyde is oxidized and the other is reduced. The oxidation yields carboxylic acid and reduction alcohol. (Mechanism already discussed in exercise questions section given above.

Benedict's solution are some examples of mild oxidizing agents.

10. Convert formaldehyde to meta-formaldehyde?

Ans Formaldehyde polymerizes in the presence of dil.H_2SO_4 to give Meta formaldehyde as shown below.



Metaformaldehyde

11. What is the importance of converting aldehyde to Acetal?

Ans: Aldehydes combine with alcohols in the presence of hydrogen chloride gas to form acetal as shown below.

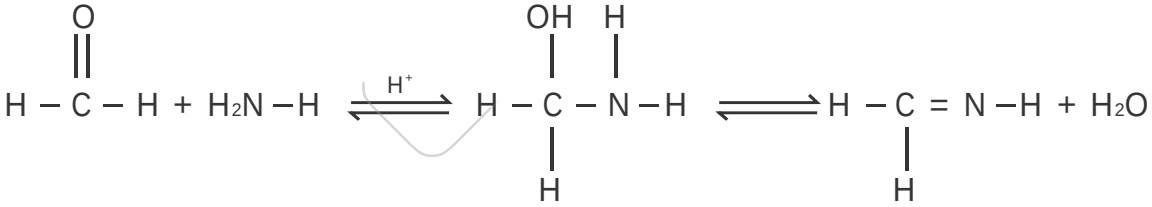
1,1-Diethoxyethane (an acetal)

Importance of reaction:

The reaction may be used to protect the aldehyde group against alkaline oxidizing agents. To regenerate Aldehyde, the Acetal is hydrolyzed in the presence of an acid.

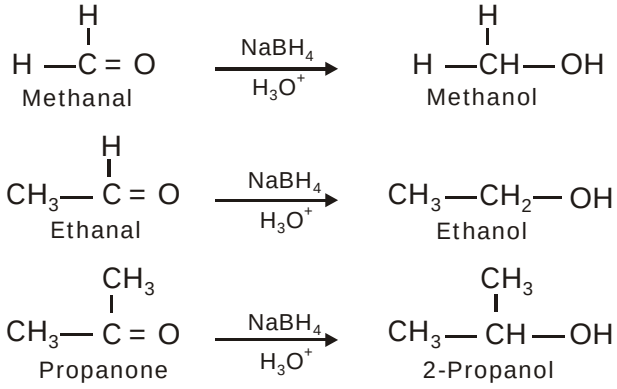
12. Describe reaction of aldehyde with ammonia?

Ans: Aldehyde and Ketones react with ammonia ($H-NH_2$) to form compounds containing the group -C = N and water. The reaction is known as condensation reaction or elimination reaction because water is lost after addition occurs. This reaction is acid catalyzed.



13. How aldehydes and Ketones are reduced to alcohols?

Ans: Aldehydes and ketones are reduced to alcohols with sodium borohydride ($NaBH_4$) in acidic medium.



14. Write the names of those weak oxidizing agents which can oxidize aldehydes but not ketones.

Ans: Some examples of such oxidizing agents are as follows

(i) Fehling's solution (an alkaline solution containing a cupric tartarate complex ion)
(ii) Benedict's solution (an alkaline solution containing a cupric citrate complex ion)
(iii) Tollen's reagent (ammonical silver nitrate solution)

15. Why the oxidation of Ketones is difficult?

Ans: Ketones do not undergo oxidation easily because they require breaking of strong carbon – carbon bond. They give no reaction with mild oxidizing agents. They are only oxidized by strong oxidizing agents such as $K_2Cr_2O_7/H_2SO_4$, $KMnO_4/H_2SO_4$, and conc. HNO_3

16. What are the factors which make aldehydes more reactive than Ketones?

Ans: The following two factors account for this:

i) The presence of hydrogen atom with the carbonyl group in aldehyde decreases steric hindrance around carbonyl carbon. In ketones there is more steric hindrance.

ii) In ketones the two alkyl groups (electron donating groups) decrease the electrophilic character of carbonyl carbon atom to a great extent while one alkyl group in aldehyde does not decrease the electrophilic character of carbonyl carbon atom to that extent.

17. How aldehydes are identified by Tollen's test? OR
Tollen's test is also called silver mirror test. Justify it.

Ans: Tollen's Test [Silver Mirror Test]:

Aldehydes form silver mirror with Tollens' reagent (ammonical silver nitrate solution). Add Tollens' reagent to an aldehyde solution in a test tube and warm. A silver mirror is formed on the inside of the test tube.

$$AgNO_3 + 3NH_4OH \rightleftharpoons [Ag(NH_3)_2]OH + NH_4NH_4NO_3 + 2H_2O$$

$$R\text{-}CHO + 2[Ag(NH_3)_2]OH \rightleftharpoons R\text{-}COONH_4 + 2Ag + 2NH_3 + H_2O$$

Silver mirror

18. Give examples of mild oxidizing agents?

Ans: The reagents or compounds which can only oxidize aldehydes and not the ketones are called mild oxidizing agents such as Tollen's reagent, Fehling's solution etc.

19. Fehling's solution reacts with aldehydes to give red ppt. justify it.

Ans: Fehling's solution is a mixture of $Cu(OH)_2$, NaOH and tartaric acid. It reduces aldehyde and produces brick red ppt of Cu_2O on heating.

$$H-\underset{\|}{\overset{O}{C}}-H + Cu(OH)_2 + NaOH \xrightarrow{\text{Tataric acid}} R-\underset{\|}{\overset{O}{C}}-ONa + Cu_2O\downarrow + H_2O$$

Sodium salt of acid Red ppt.

20. How is acetaldehyde distinguished from formaldehyde?

Ans:

Acetaldehyde (Ethanal)	Formaldehyde (Methanal)
Ethanal produces yellow ppt of Iodoform (CHI_3) with NaOH and I_2. $CH_3\text{-}CHO + 3I_2 + 4NaOH \rightarrow CHI_3 + HCOONa + 3NaI + 3H_2O$	Methanal does not produce Iodoform with NaOH and I_2. $H\text{-}CHO + I_2 + NaOH \rightarrow$ No reaction

21. How Iodoform is prepared from ethanol and acetaldehyde?

Ans: **Preparation of i**odoform from ethanol and acetaldehyde:

Heating ethanol or acetaldehyde with NaOH and solid iodine gives Iodoform as follows:-

$$C_2H_5OH + 4I_2 + 6NaOH \rightarrow CHI_3 + HCOONa + 5NaI + 5H_2O$$
$$CH_3\text{-}CHO + 3I_2 + 4NaOH \rightarrow CHI_3 + HCOONa + 3NaI + 3H_2O$$

22. Give 4 uses of formaldehyde.

Ans: Uses of formaldehyde:

i) It is used in the manufacture of resins (polymers) like urea-formaldehyde and plastics such as Bakelite.

ii) It is used in the manufacture of dyes such as indigo, para-rosaniline (green crystalline solid) etc.

iii) Its 40% aqueous solution called formalin is used as an antiseptic, a disinfectant, a germicide, a fungicide and for preserving animal specimens and sterilizing surgical instruments.

iv) It is used as a decolorizing agent in vat dyeing (dying of cotton and wool in vessels).