

16. Carbonyl Compounds

- Ketones can also be prepared through oxidation of alkenes (2 carbon atoms attached to 2 alkyl groups) OR through Friedel-Crafts Acylation (in anhydrous conditions with Lewis Acid catalyst).
- To produce aldehydes, add $K_2Cr_2O_7$ and heat with **immediate distillation** (orange turns green). Immediate distillation will prevent further oxidation by $K_2Cr_2O_7$. Distillation is possible due to the lower boiling point of aldehydes due to weaker pd-pd forces between aldehyde molecules vs strong hydrogen bonds between alcohol molecules.
- Carbonyl compounds do not undergo nucleophilic substitution (addition instead) because, the C-C bond or C-H bond would have to be broken and breaking of these two bonds is energetically demanding.
- Carbonyl compounds can be reduced by $NaBH_4$ in methanol and H_2 , Ni, heat. As compared to carboxylic acids, which can only be reduced by $LiAlH_4$.
- In nucleophilic addition of CN^- , conditions are HCN with trace amount of KCN at 10-20 degrees Celsius OR HCN with a small amount of KOH at $pH < 9$
 - > Dilute H_2SO_4 and KCN are usually used to generate HCN *in situ*.
 - > HCN is a weak acid and thus dissociates only partially to give CN^- .
 - > To increase CN^- , either add small amount of strong base, to remove H^+ and shift eqm position to the right, thus increasing production of CN^- .
 - > OR, add strong electrolyte containing CN^- , complete dissociation of electrolyte provides sufficient CN^- to start off the reaction.
- However **HCN** has to be used regardless as besides from providing the nucleophile, it acts as a proton donor in step 2 of nucleophilic addition
- $LiAlH_4$ **cannot be used to reduce alkenes** as it is triggered by the H^- nucleophile and the $C=C$ bond in alkenes will repel the H^- nucleophile
- **Aromatic carbonyl compounds** are less reactive towards nucleophilic attack as the carbonyl C atom is less electron-deficient due to interaction of the pi electron cloud of the carbonyl group and that of the adjacent benzene ring. **Furthermore, the bulky benzene ring poses steric hindrance to the approaching nucleophile.**
- **NOTE:** For positive iodoform test, other than CH_3 connected, if CH_2I connected, will also give positive test!
- **NOTE:** Tollen's reagent will also give a positive test in methanoic acid!