

ALDEHYDES AND KETONES

112 - team 6

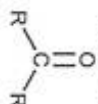
OPTICAL ISOMERISM

CARBONYL COMPOUNDS

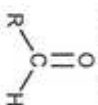
Carbonyl compounds contain a carbonyl group, C=O.

Examples include:

Ketones



Aldehydes



GENERAL FORMULA

The general formula of these compounds is:

Ketones



Aldehydes



QUALITATIVE TESTS

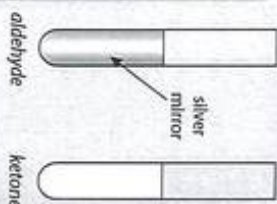
TOLLENS' REAGENT

Tollens' reagent forms a silver mirror when warmed with an aldehyde but not a ketone.

The silver oxidises the aldehyde to a carboxylic acid.



The silver ions are reduced from Ag^+ to Ag .

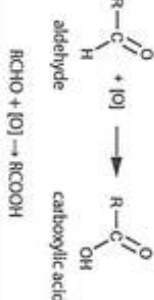


FEHLING'S SOLUTION

Fehling's solution can be used to distinguish an aldehyde from a ketone. Aldehydes form a brick-red precipitate with Fehling's solution, but Fehling's solution remains blue with ketones.

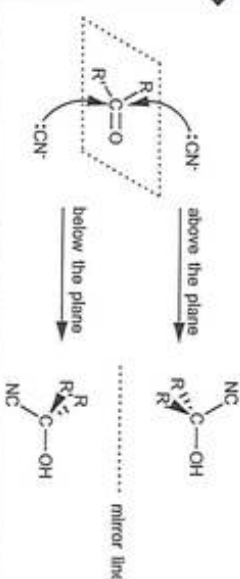
OXIDATION OF ALDEHYDES

Aldehydes are converted into carboxylic acids by refluxing with acidified $\text{K}_2\text{Cr}_2\text{O}_7$ and with an acid catalyst. This is represented as $[\text{O}]$ in reactions.

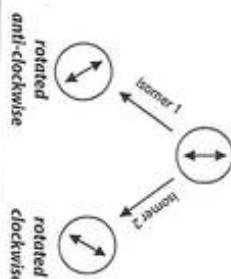


MIXTURES OF PRODUCTS

Aldehydes and unsymmetrical ketones form a racemic mixture of hydroxynitrile optical isomers when they react with HCN followed by dilute acid. This is because the CN^- can approach the planar carbonyl bond from either side.



Optical isomers got their name from the way they interact with light. When plane-polarised light is shone through a sample of an optical isomer, the sample rotates the light clockwise or anticlockwise.



OPTICAL ISOMERISM

Optical isomerism is a type of stereoisomerism (molecules which differ by their arrangement in space).

The two isomer molecules are non-superimposable mirror images. Look at molecules 1 and 2. No matter how you rotate molecule 1, it will never completely overlap molecule 2. Molecules 1 and 2 can form optical isomers because they have a **chiral centre**. This is the carbon with four different groups attached. These four different groups make the carbon asymmetrical.

EXAM TIP

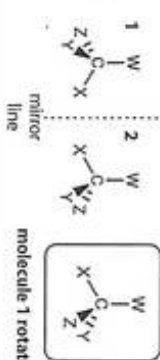
You don't need to know which isomer rotates light which way.

RACEMIC MIXTURES

A racemic mixture, or racemate, is an equal mixture of each isomer. These are optically inactive – they do not rotate plane-polarised light because the effects of the two isomers cancel out.

EXAM TIP

When drawing optical isomers, always draw them in this format.



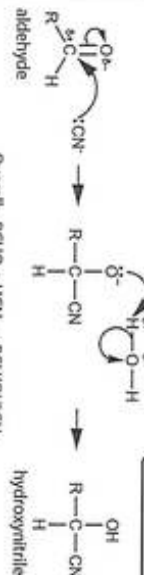
NUCLEOPHILIC ADDITION

KCN is a hazardous reagent because it reacts with water to form HCN, which is highly toxic.

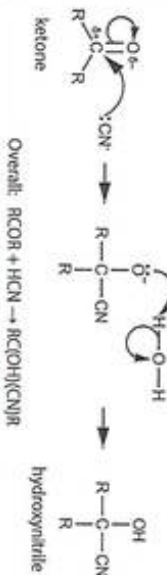
HYDROGEN CYANIDE

CN^- is the cyanide ion. It is a powerful nucleophile formed from NaCN (or KCN) in acid. In equations sometimes HCN is used, but CN^- is still reacting.

ALDEHYDE



KETONE



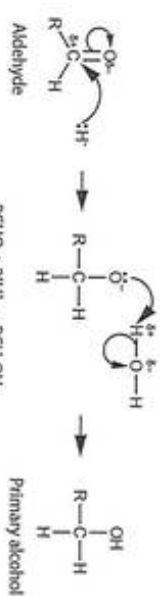
EXAM TIP

HCN is not used directly as a reagent as it is too toxic.

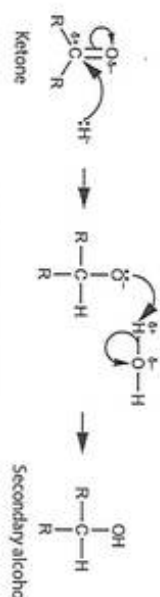
REDUCTION

Aqueous sodium borohydride, NaBH_4 , is a source of H^- , the hydride ion, which reduces aldehydes/ketones to alcohols.

Aldehydes are reduced to primary alcohols.



Ketones are reduced to secondary alcohols.



Note: The $[\text{H}]$ represents hydrogen from a reducing agent.