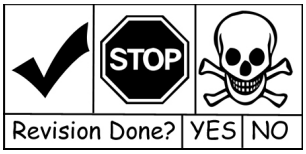
Unit 13 Optical Isomerism etc (Paper 2 & 3)

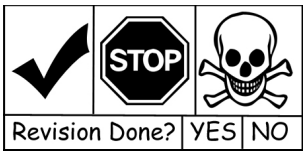
13.1 Optical isomerism

Optical isomerism is a form of stereoisomerism and occurs as a result of chirality in molecules, limited to molecules with a single chiral centre.
An asymmetric carbon atom is chiral and gives rise to optical isomers (enantiomers), which exist as non-super-imposable mirror images and differ in their effect on plane polarised light.
A mixture of equal amounts of enantiomers is called a racemic mixture (racemate).
You should be able to:
• draw the structural formulas and displayed formulas of enantiomers
• understand how racemic mixtures (racemates) are formed and why they are optically inactive.



13.2 Aldehydes and ketones

Aldehydes are readily oxidised to carboxylic acids.
Chemical tests to distinguish between aldehydes and ketones including Fehling's solution and Tollens' reagent.
Aldehydes can be reduced to primary alcohols, and ketones to secondary alcohols, using $NaBH_4$ in aqueous solution.
These reduction reactions are examples of nucleophilic addition.
The nucleophilic addition reactions of carbonyl compounds with KCN, followed by dilute acid, to produce hydroxynitriles.
Aldehydes and unsymmetrical ketones form mixtures of enantiomers when they react with KCN followed by dilute acid.
The hazards of using KCN.
You should be able to:
• write overall equations for reduction reactions using [H] as the reductant
• outline the nucleophilic addition mechanism for reduction reactions with $NaBH_4$ (the nucleophile should be shown as H^-)
• write overall equations for the formation of hydroxynitriles using HCN
• outline the nucleophilic addition mechanism for the reaction with KCN followed by dilute acid
• explain why nucleophilic addition reactions of KCN, followed by dilute acid, can produce a mixture of enantiomers.



13.3 Carboxylic acids and derivatives

Carboxylic acids and esters
The structures of:
• carboxylic acids
• esters.
Carboxylic acids are weak acids but will liberate CO_2 from carbonates.
Carboxylic acids and alcohols react, in the presence of an acid catalyst, to give esters.
Common uses of esters (eg in solvents, plasticisers, perfumes and food flavourings).
Vegetable oils and animal fats are esters of propane-1,2,3-triol (glycerol).
Esters can be hydrolysed in acid or alkaline conditions to form alcohols and carboxylic acids or salts of carboxylic acids.
Vegetable oils and animal fats can be hydrolysed in alkaline conditions to give soap (salts of long-chain carboxylic acids) and glycerol.
Biodiesel is a mixture of methyl esters of long-chain carboxylic acids.
Biodiesel is produced by reacting vegetable oils with methanol in the presence of a catalyst.

Acylation
The structures of:• acid anhydrides • acyl chlorides • amides.
The nucleophilic addition–elimination reactions of water, alcohols, ammonia and primary amines with acyl chlorides and acid anhydrides.
The industrial advantages of ethanoic anhydride over ethanoyl chloride in the manufacture of the drug aspirin.
You should be able to outline the mechanism of nucleophilic addition–elimination reactions of acyl chlorides with water, alcohols, ammonia and primary amines.