Definitions and Concepts for Edexcel Chemistry A-level

Topic 17: Organic Chemistry 2

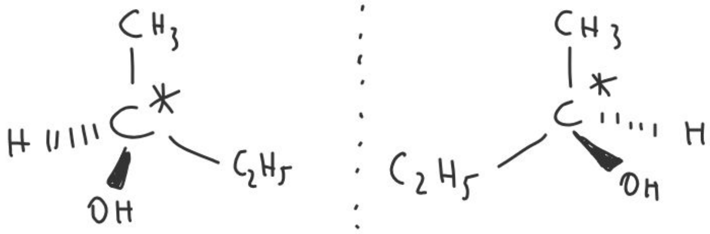
Chiral centre: A carbon atom bearing four different substituents. Marked with an asterisk (*). Also: *asymmetric carbon*.

Chirality: When a compound and its mirror image are non-superimposable (optical isomerism).

Plane-polarised light: Monochromatic light that oscillates only in one plane. By contrast, *unpolarised* light oscillates in all planes perpendicular to the direction of travel. A *polariser* is a device that converts the unpolarised light to plane-polarised light.

Polarimeter: A device for measuring an angle of rotation caused by a chemical. Plane polarised light passes through the *analyser*.

Enantiomers: Optical isomers that are mirror images of each other. They rotate the plane of polarisation of plane-polarised light.



Optical activity: The ability of a single optical isomer to rotate the plane of polarisation of plane-polarised monochromatic light. An optically active molecule has no planes of symmetry.

Racemic mixture: An equimolar mixture of enantiomers of a chiral compound. Doesn't rotate the plane of polarisation of the plane-polarised light, as the two enantiomers cancel out each others light rotating effect.

Dimer: A molecule consisting of two identical molecules (monomers) linked together.

Esterification: Reaction of an alcohol with a carboxylic acid in presence of an acid catalyst to form an ester.

e.g. $CH_3OH + CH_3COOH \rightleftharpoons CH_3COOCH_3 + H_2O$ (catalysed by conc. H_2SO_4)

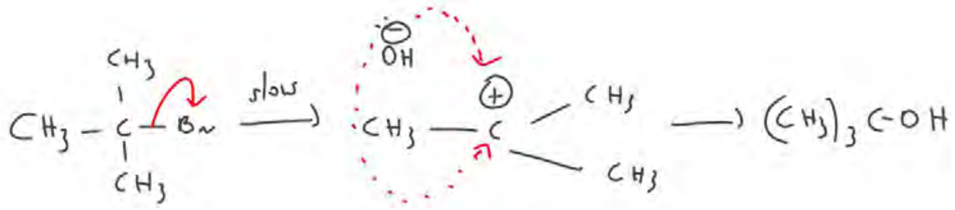
The process of breaking down the ester bond with water is a hydrolysis reaction. Acidic hydrolysis is a reversible reaction (see above equation). Hydrolysis under basic conditions results in an irreversible reaction, e.g.

$$CH_3COOCH_3 + NaOH \rightarrow CH_3COONa + CH_3OH$$

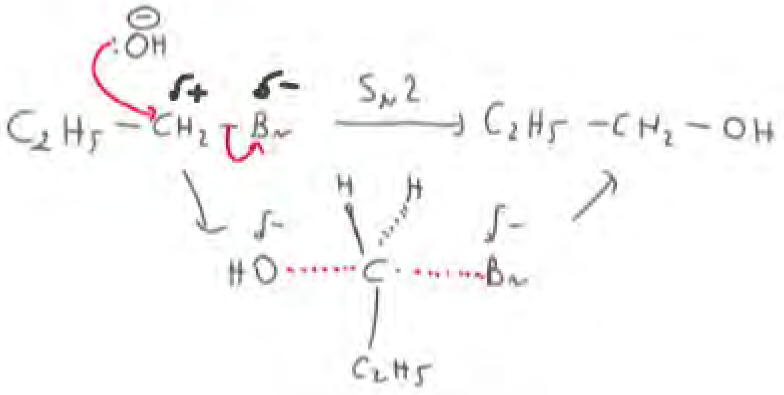
Condensation polymerisation: A reaction in which monomers link together to form a large molecule with the additional formation of small molecule, e.g. H_2O, HCl. Forms polyesters and polyamides.

Saponification: Refers to the process of making soap. In practice, it is a basic hydrolysis of long-chain triglycerides to glycerol and corresponding salts of carboxylic acids.

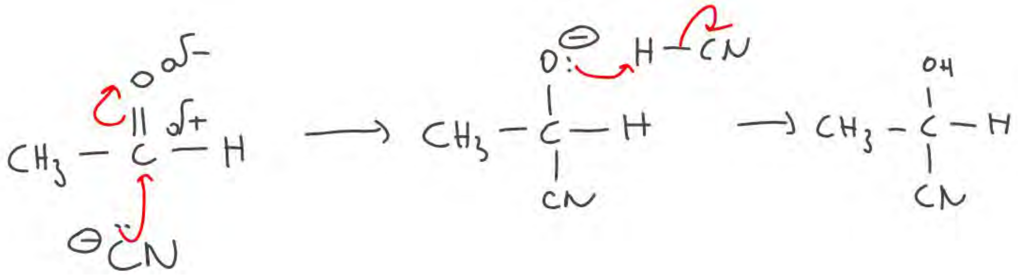
S_N1: Nucleophilic substitution, unimolecular (one species in the slow step). The slow step is the heterolytic fission of a haloalkane to give the carbocation, which is then attacked by a nucleophile. Even if the reaction is performed on a chiral carbon centre, the carbocationic intermediate is planar, hence the nucleophile can attack it from both sides with an equal probability. The outcome is therefore the racemisation at a chiral centre. The reaction is 1st order w.r.t the haloalkane and 0th w.r.t the nucleophile. Common with tertiary haloalkanes (hindered nucleophile approach, compare with S_N2 that occurs with primary haloalkanes).



S_N2: Nucleophilic substitution, bimolecular (two species in the slow step). A single step mechanism that involves the direct attack of the nucleophile on the haloalkane. If the reaction is performed on a chiral centre, the reaction causes the inversion of the configuration, as the nucleophile approaches the carbon from the opposite site to the leaving group. The reaction is 1st order w.r.t the haloalkane and 1st order w.r.t the nucleophile. Common with primary haloalkanes.



Nucleophilic addition: A mechanism that involves the addition of a nucleophile to the electrophilic polar double bond, e.g. nucleophilic addition of a cyanide anion to ethanal.



Tollens' test: A test that differentiates between aldehydes and ketones. It employs the ability of aldehydes to undergo oxidation reactions and the fact that ketones are not easily oxidised. The Tollens' reagent is a colourless silver (I) complex ($Ag(NH_3)_2^+$). The positive test results in oxidation of the aldehyde to the corresponding carboxylic acid and reduction of the silver complex to the metallic silver (hence silver mirror can be observed). Ketones do not reduce the Tollens' reagent.

Fehling's and Benedict's tests: Same principles as above, but the test reagent is a Cu^{2+} complex. Aldehyde will undergo a redox reaction to reduce the deep blue copper (II) complex to the brick red precipitate (Cu_2O, copper on +I oxidation state).

Brady's reagent: 2,4-dinitrophenylhydrazine. Used for testing for a presence of a carbonyl group (a test for aldehydes and ketones). A positive test results in the formation of the bright orange precipitate. The obtained derivative can be purified *via* recrystallisation and its melting point can be measured. Comparing the result with literature values can help identify the derivative.

Iodoform (triiodomethane) reaction: A reaction used for identification of ethanol, ethanal, methyl ketones (e.g. propanone) and secondary alcohols bearing a methyl group on the C-OH carbon (e.g. propan-2-ol). Involves warming the compound of interest with iodine in alkaline solution. The positive result is the appearance of a yellow, crystalline precipitate with a characteristic smell.