Isomerism

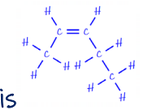
Structural/constitutional

Same number AND type of atoms but different connectivity e.g. butane and methyl propane (C_4H_{10}), and propan-2-ol and propan-1-ol (C_3H_7OH)

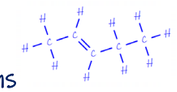
Stereoisomers

Same number AND type of atoms AND same connectivity but different arrangement in space.

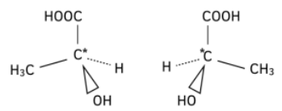
- Geometrical cis / trans. Need to have a C=C (allows no free rotation) as well as each C of the C=C must be bonded to 2 different atoms/groups e.g.



cis vs trans



- Optical / enantiomers . Have chiral / asymmetric C atom / C bonded to 4 different atoms/groups. Enantiomers are non-superimposable mirror images. Same mpt, bpt and solubility. Can be distinguished by the fact they rotate plane-polarised light in opposite directions.



Acidic and basic hydrolysis of esters and amides

	Ester	Amide
Acidic	 R-COOH and HO-R	 R-COOH and $H_3\overset{+}{N}$-R
Basic	 $R\text{-}COO^-Na^+$ and HO-R	 $R\text{-}OO^-Na^+$ and H_2N-R

In acid $R\text{-}NH_2$ is protonated to $R\text{-}NH_3^+$. In base R-COOH is deprotonated to $R\text{-}COO^-$.

Hydrolysis reaction Reaction with water; acidic H_2O/H^+, heat or basic NaOH(aq), heat

Condensation reaction Two molecules join to make a larger molecule and a small molecule is lost (often H_2O or HCl).

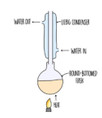
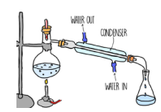
Naming: 1 – meth, 2 – eth, 3- prop, 4 – but, 5- pent, 6- hex, 7- hept, 8 – oct. Molecules with C=O on end (c. acids, acyl chlorides, amides, aldehydes – that C is always designated C #1.

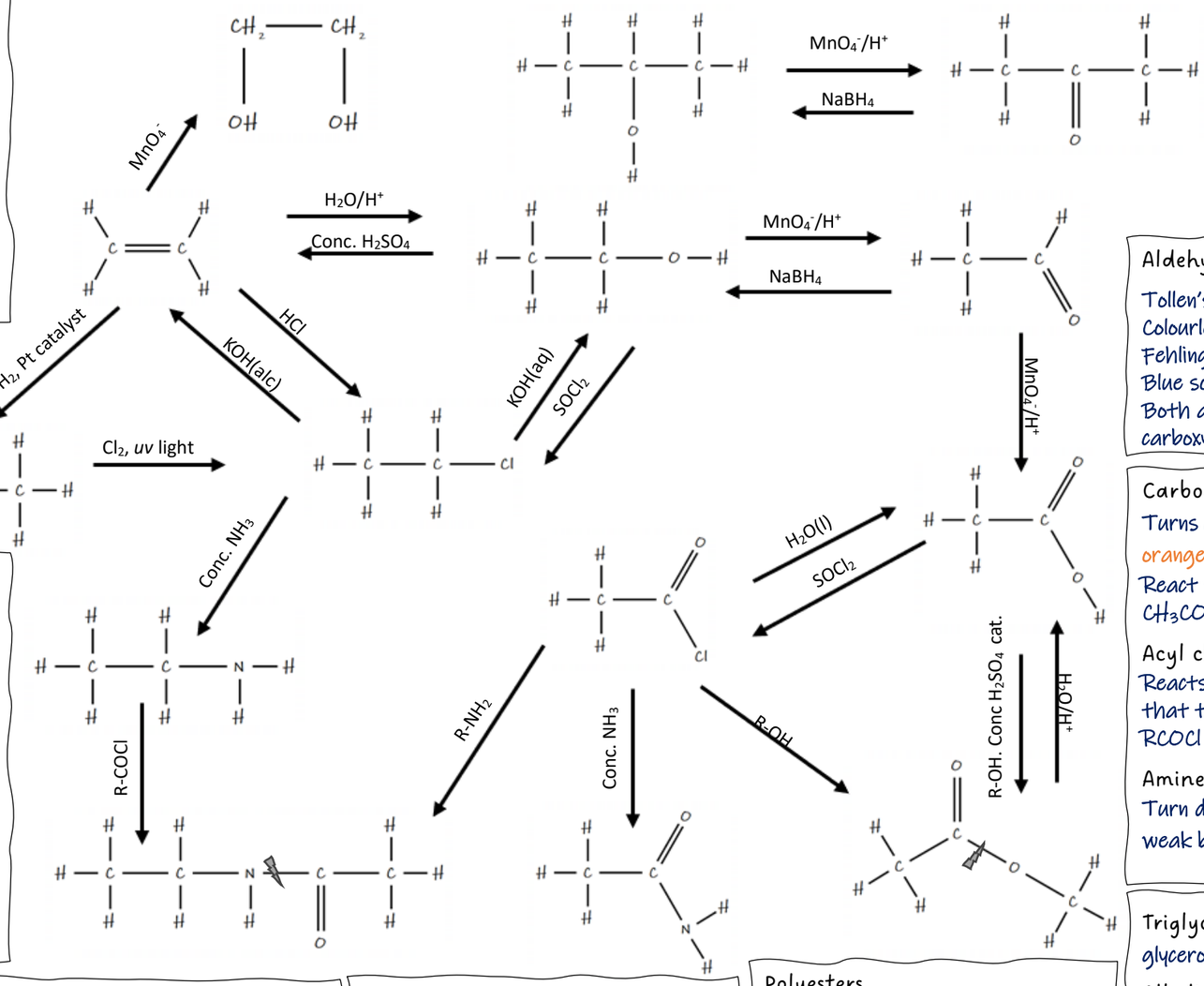
Predicting major/minor products

Addition: the rich get richer (C with most H atoms gains the H atom). Elimination: the poor get poorer (C with least H atoms loses the H atom)

- Both rules predict the MAJOR product
- Clues to look for: alkene or alcohol needs to be unsymmetrical for there to be a major and a minor product.

Organic Techniques

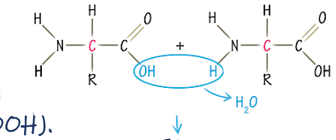
Heat under reflux	Distillation	Add .....CO_3 – will remove unreacted acid – see fizz of CO_2. Add anhydrous ..... – will remove any water. Separating funnel – to separate immiscible liquids e.g. organic and aqueous layers.
		
Heat to speed up reaction without losing reactants /products	Separation & purification based on boiling point	



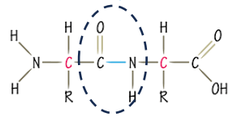
If you need to move position of a functional group e.g. -OH group to turn propan-1-ol to propan-2-ol, go VIA an alkene (elim followed by addition)

Polypeptide

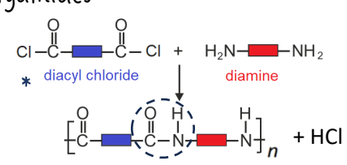
Formed from amino acids (contain both $-NH_2$ and -COOH).



Connected by amide bonds/links

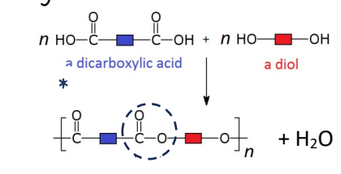


Polyamides



*OR dicarboxylic acid + heat, makes H_2O

Polyesters



*OR diacyl chloride, makes HCl

Can make from a single monomer (homopolymer) if it has BOTH functional groups e.g. polyester from molecule with OH and COOH on opposite ends. Need both functional groups so the chain is able to extend in both directions.

Classification: primary, secondary, tertiary

Alcohols / haloalkanes: count the # of carbon atoms attached to the carbon atom attached to the -OH / -X

Amines: classified as primary (1°), secondary (2°), or tertiary (3°), depending on how many carbon groups are connected to the nitrogen atom 1° RNH_2 2° R_2NH 3° R_3N

Alcohols R-OH C1-4/5 are soluble in water.

Oxidation:

Use MnO_4^-/H^+ (purple to colourless Mn^{2+}) or $Cr_2O_7^{2-}/H^+$ (orange to green Cr^{3+})

1° → aldehydes → carboxylic acids

2° → ketones (and then NOT further oxidised)

3° (NOT oxidised by these).

Aldehydes and ketones aldehydes ☑ ketones☒

Tollen's solution / silver nitrate test

Colourless solution forms a silver mirror as $Ag^+ + e^- \rightarrow Ag$.

Fehling's and Benedict's solution

Blue solution forms brick red ppt of Cu_2O $Cu^{2+} + e^- \rightarrow Cu^+$

Both are mild oxidising agents and oxidise the aldehyde → carboxylic acid

Carboxylic acids

Turns damp litmus paper blue → red and UI paper green → orange as weak acids; $RCOOH + H_2O \rightleftharpoons RCOO^- + H_3O^+$

React with carbonate/bicarbonate soln, see bubbles of gas $CH_3COOH + NaHCO_3 \rightarrow CH_3COONa + H_2O + CO_2$

Acyl chlorides

Reacts violently with water to give grey fumes of HCl(g) that turn damp blue litmus paper → red

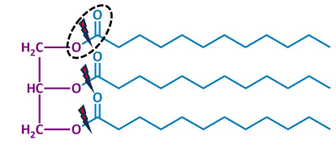
$RCOCl + H_2O \rightarrow RCOOH + HCl$

Amines

Turn damp litmus paper from red → blue as amines are weak bases $RNH_2 + H_2O \rightleftharpoons RNH_3^+ + OH^-$

Triglycerides: Are triesters made from fatty acids and a glycerol (propane-1,2,3-triol) backbone. Ester is circled.

Alkaline hydrolysis forms soaps



Heat with NaOH(aq) or KOH(aq). Ester bonds between the fatty acids and glycerol break to give propane-1,2,3-triol and the sodium salts of the fatty acids which are SOAP molecules e.g. $C_{11}H_{23}COO^-\ Na^+$.