AQA GCSE Chemistry

Topic 7: Organic chemistry

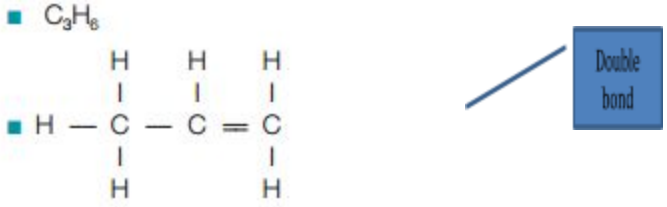
Reactions of alkenes and alcohols (chemistry only)

Notes

(Content in bold is for Higher Tier only)

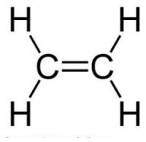
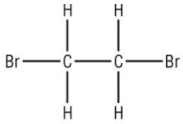
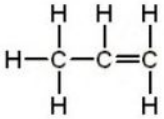
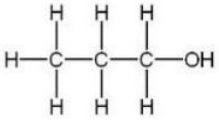
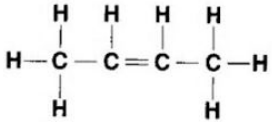
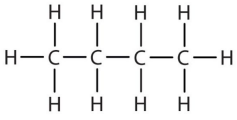
Structure and formulae of alkenes

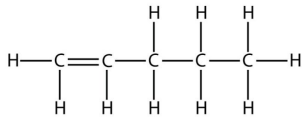
- Alkenes have the general formula C_nH_{2n}
- they have at least one carbon-carbon double bond, making them unsaturated because they contain two fewer hydrogen atoms than the alkane with the same number of carbon atoms.
- The first 4 alkenes are ethene, propene, butene and pentene
- Unsaturated carbons can be represented in the following forms:



Reactions of alkenes

- Alkenes are hydrocarbons with the functional group C=C (functional groups are usually responsible for the reactions of organic compounds)
- They react with oxygen in combustion reactions in the same way as other hydrocarbons, but they tend to burn in air with smoky flames because of *incomplete combustion* (meaning carbon or carbon monoxide is formed (CO))
- They also react with hydrogen, water and the halogens, by the addition of atoms across the carbon-carbon double bond so that the double bond becomes a single carbon-carbon bond :

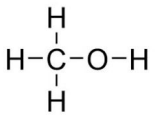
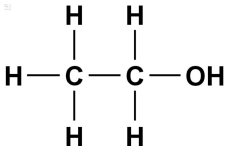
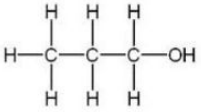
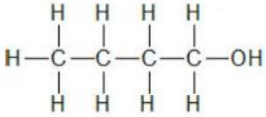
ethene	C_2H_4		plus bromine (Br_2): 
propene	C_3H_6		plus water:  propanol
butene	C_4H_8		plus hydrogen (H_2):  butane

pentene	C_5H_{10}		

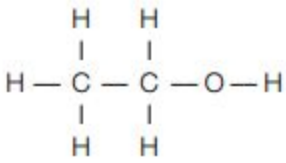
- In each reaction with hydrogen, water and halogens:
  - every reaction works the same for all alkenes, the table just shows examples.
  - the C=C bond is broken to form a C-C bond
  - the compound added splits into two groups and the two groups are added to the 2 different carbons in the C=C bond (each group can be added to either carbon)
  - H_2 splits into 2 H's, H_2O splits into a H and an OH, Br_2 splits into 2 Br's (same for Cl_2 or I_2)

Alcohols

- Alcohols contain the functional group –OH
- The first 4 members of the series are methanol, ethanol, propanol and butanol:

methanol	CH_3OH	
ethanol	C_2H_5OH	
propanol	C_3H_7OH	
butanol	C_4H_9OH	

- alcohols can be represented by:



CH_3CH_2OH

Reactions of methanol, ethanol, propanol and butanol:

- They burn in air, which produces carbon dioxide and water
- They dissolve in water to form a neutral solution (has a pH of 7)
- They react with sodium to produce hydrogen and a salt (e.g. C_2H_5ONa- the H has been given off and Na has been added)
- They react with oxidising agents to form carboxylic acids

Uses of methanol, ethanol, propanol and butanol:

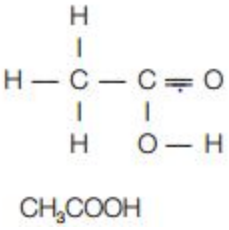
- methanol: chemical feedstock, in anti-freeze, to make biodiesel
- Ethanol: the main alcohol in alcoholic drinks, used as a solvent and fuel
- All 4: can be used as fuels

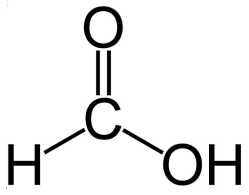
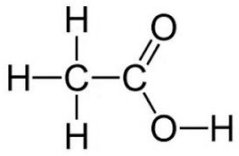
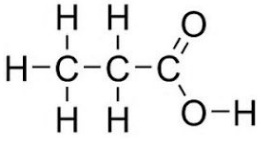
Producing ethanol:

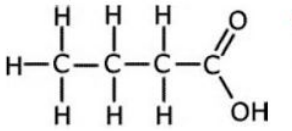
- Ethanol can be produced by fermentation of sugar with yeast, using renewable sources.
- Conditions: about 35°C, anaerobic (without oxygen) and yeast enzyme catalyst
- Sugar → ethanol + carbon dioxide

Carboxylic acids

- Ethanoic acid is a member of the carboxylic acids, they have the functional group –COOH.
- First four members are: methanoic acid, ethanoic acid, propanoic acid and butanoic acid:



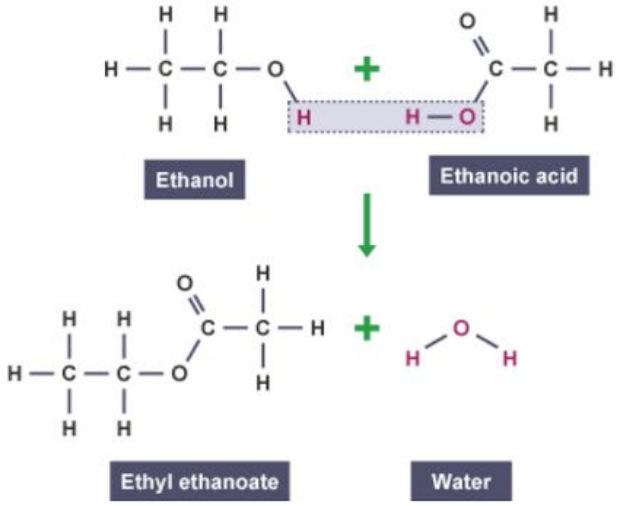
methanoic acid	CHOOH	
ethanoic acid	CH_3COOH	
propanoic acid	C_2H_5COOH	

butanoic acid	C_3H_7COOH	

Reactions of methanoic acid, ethanoic acid, propanoic acid and butanoic acid:

- They dissolve in water to produce acidic solutions (pH less than 7)
- They react with metal carbonates to produce carbon dioxide (turns limewater cloudy), a salt and water
- React with alcohols in the presence of an acid catalyst to produce esters

- React with alcohols to produce esters…



You don't need to know this equation and the only ester you need to know the name of is ethyl ethanoate

- **They do not ionise completely in solutions, so do not release many H^+ ions, making carboxylic acids weak acids.**
- **This means they have a higher pH (less acidic) than solutions of strong acids of the same concentration.**