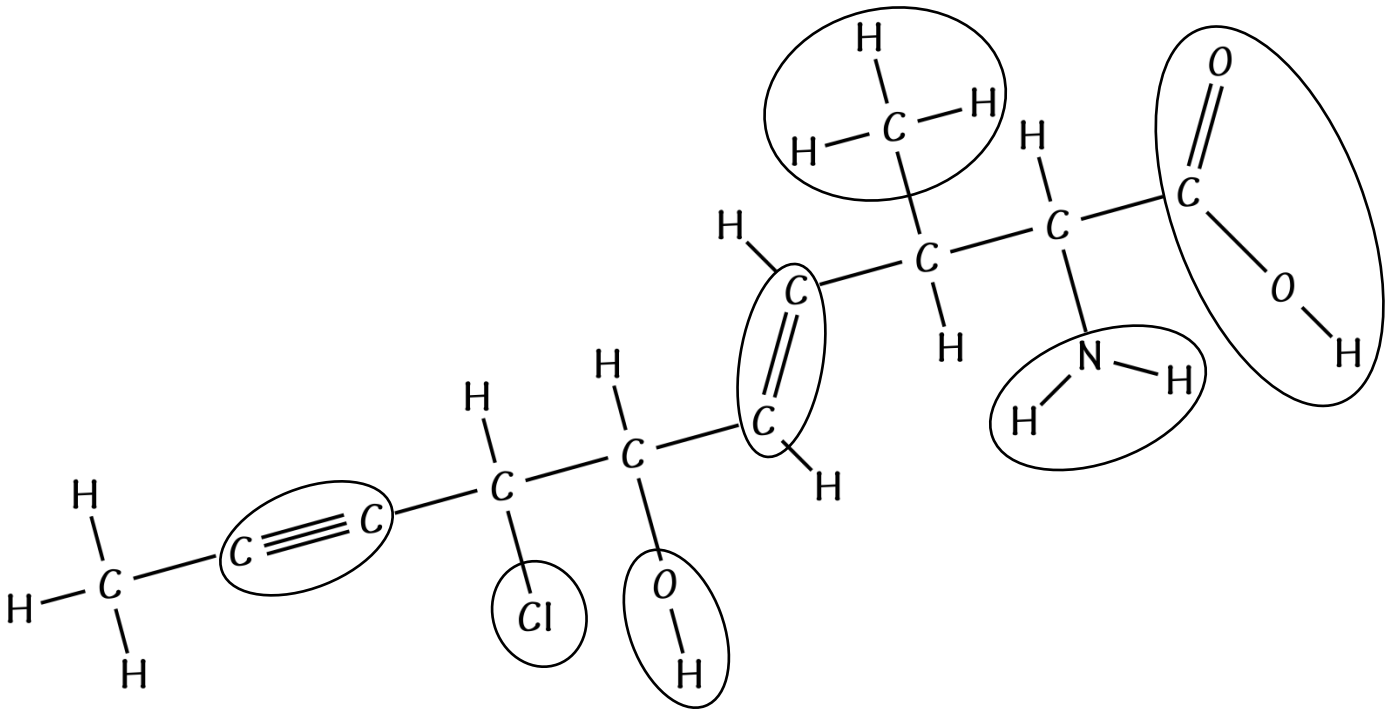
ORGANIC SURVIVAL SHEET

1 meth-, 2 eth-, 3 prop-, 4 but-, 5 pent-, 6 hex-, 7 hept- , 8 oct-

FUNCTIONAL GROUPS

(No you won't have to name this molecule!!)



From Left to right: Alkyne, haloalkane (chloro), alcohol, alkene, methyl group, amine, carboxylic acid

Naming (*pointless if you can't name 1-8 C atoms and don't recognise the functional groups*!)

Numbering of the chain starts from the end that carries the main functional group, and has smallest number e.g. 2-chlorohexane and NOT 5-chlorohexane

Haloalkane -X e.g. chloroethane

Alcohol -ol e.g. ethanol, propan-1-ol. (-OH is hydroxy as a side chain on a carboxylic acid)

Alkene -ene e.g. ethene, but-2-ene

Alkyne -yne e.g. propyne, but-2-yne

Alkyl group $-CH_3$ methyl, $-C_2H_5$ ethyl etc

Amine – NH_2 e.g. methanamine, propan-1-amine ($-NH_2$ is amino as a side chain on a c.acid or alcohol)

Carboxylic acid -COOH e.g. butanoic acid (is always C atom #1 to count from when naming)

Saturated and unsaturated hydrocarbons and how to test for

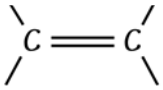
- Saturated hydrocarbons have C-C bonds; each C atom is bonded to 4 other atoms.
  - Orange (red-brown) bromine water Br_2 is slowly decolourised; needs UV light and/or heat - SUBSTITUTION
- Unsaturated hydrocarbons have C=C or C≡C bonds; not every C atom is bonded to 4 other atoms
  - Orange bromine water is rapidly decolourised (no need for UV and/or heat) – ADDITION
  - Alkene + purple H^+/MnO_4^- solution reacts to form a diol and the solution becomes colourless - OXIDATION

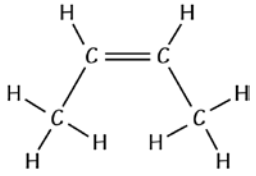
ISOMERS

A *structural* (constitutional) *isomer* has the same molecular formula (same number of each type of atoms), but a different arrangement of atoms (Could be any of straight chain / branched chain or position of functional group or type of functional group).

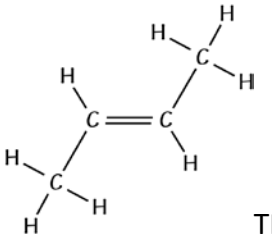
Geometrical isomers (cis and trans) have

- a C=C double bond (which cannot rotate)
- atoms / groups on each of the carbons of the double bond that are different.
- If one C of the C=C has 2 atoms/ groups the same e.g. 2 H's or 2 CH_3's then if these were swapped it would still be the same molecule so that molecule can't have cis or trans isomers

- The KEY is to draw them in  shape. C shape = cis.



CIS



TRANS

REACTION TYPES

<u>Substitution</u>

An atom or group of atoms is replaced with another atom or group of atoms. There are 2 products.

- Alkane → haloalkane: Br_2 water and UV light and/or heat
- Alcohol → chloroalkane: $SOCl_2$ or PCl_5 or PCl_3 or HCl (bromoalkane write Br instead of Cl)
- Haloalkane → alcohol: KOH(aq), heat
- Haloalkane → amine: conc NH_3(alc), heat

<u>Addition</u>

The double bond is broken and two atoms/groups are added to each C atom of the double bond. There is one saturated product.

- Alkene → alkane: H_2(g), Pt (or Ni) catalyst
- Alkene → alcohol: H^+/H_2O, heat
- Alkene → haloalkane: Add HX(g) or X_2(g) (would make dichloro, dibromo etc)

Addition reactions making 2 products

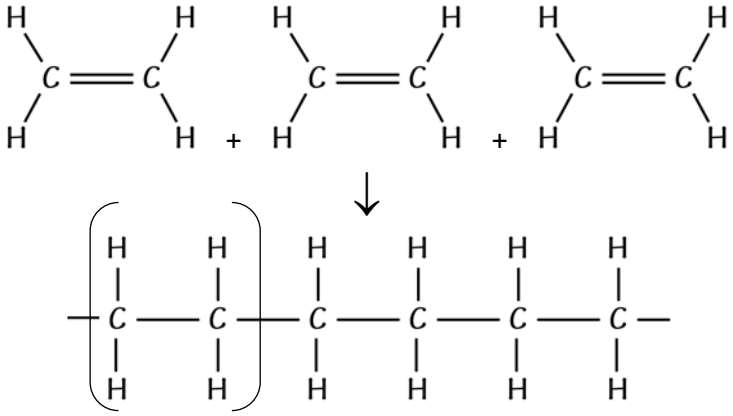
*There are two products if an asymmetric reagent e.g. H-OH (or H-Br or H-Cl) adds onto an asymmetric alkene (CH_3**<u>C</u>**H=**<u>C</u>**H_2). There are two carbons that the H or OH of water can bond with so there are two possible combinations.*

Predict the major product by using Markovnikov's rule, which states that the carbon with the most hydrogens gains more hydrogens (rich get richer). The other product will be the minor product.

- Addition polymerisation

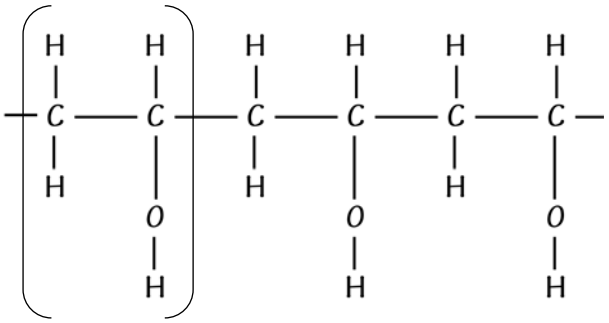
  Addition polymerisation occurs when the C=C in monomers breaks and the carbon atoms in this double bond join to each other from adjacent molecules to form long chains

  E.g. Monomer = ethene, polymer = polyethene

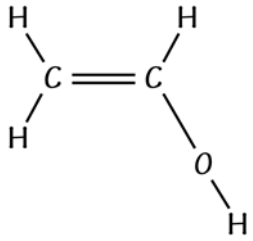


  Be able to draw for ethene and then you can do for any monomer! [ ] shows one repeating unit. To do for other monomers simply draw them as if it was ethene polymerising and then replace the H's with what was on the monomer you were given.

  To draw a monomer from a section of polymer find the repeating unit and make C-C into C=C.



  Monomer would be



Elimination

Two atoms / groups are removed from adjacent carbon atoms and a double bond is created to form an alkene.

  Alcohol $\rightarrow$ alkene: conc. H_2SO_4 , sulfuric acid (H and OH removed, C=C made)

  Haloalkane $\rightarrow$ alkene: KOH(alc), heat (H and X removed, C=C made)

  Elimination reactions making 2 products

  There are two products if the alcohol can lose an OH and a H from the C on either side.

  There are two products if the haloalkane can lose an X and a H from the C on either side.

  Predict the major product - the carbon with the least hydrogens loses the hydrogen (poor get poorer). The other product will be the minor product. (Saytzeff's rule).

Oxidation

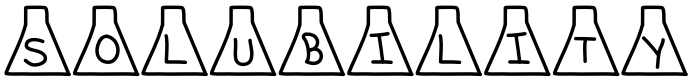
Reaction with either MnO_4^- OR $Cr_2O_7^{2-}$, both "oxidising agents" – usually used "acidified", i.e. with H^+

- 1^o alcohol $\rightarrow$ carboxylic acid: MnO_4^-/H^+ heat OR $Cr_2O_7^{2-}/H^+$, heat. (2^o and 3^o NOT converted to carboxylic acid)
- Alkene $\rightarrow$ diol: MnO_4^-/H^+ (purple to colourless) or MnO_4^- (purple to brown)

Acid-base

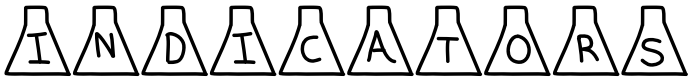
Reaction of carboxylic acid with base NaOH (no visible reaction) or carbonate $NaHCO_3$ or Na_2CO_3 (both release CO_2 gas). The acid donates a proton. Will make ionic salts, e.g. $CH_3COO^- Na^+$. CH_3COO^- is the ethanoate ion.

Reaction of amine with HCl or H_2SO_4 (no visible reaction). The base accepts a proton from the acid. Will make (ionic) salts e.g. $CH_3NH_2 + HCl \rightarrow CH_3NH_3^+ Cl^-$



Water is a polar molecule. Any (aq) solution also contains mostly water! Remember this!!

- If the organic molecule is non-polar (alkane, alkene, alkyne) it will not dissolve in water / is insoluble. Two layers will form.
- For soluble organic molecules as #C↑ solubility ↓ (as non-polar hydrocarbon bit gets bigger).
- Small alcohols (C1-3), small carboxylic acids (C1-4) and small amines (C1-5) are soluble as the -OH and -COOH and $-NH_2$ groups are polar and are attracted to polar water molecules. One layer only.



Litmus and UI paper – must be MOIST/DAMP

The only organic acids at L2 are carboxylic acids.

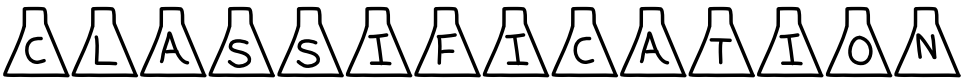
- Blue litmus turns red, red litmus stays red
- Green UI turns orange (weak acid)

The only organic bases are L2 are amines.

- Red litmus turns blue, blue litmus stays blue
- Green UI turns blue (weak base)

Alcohols – neutral (no change to litmus or UI).

All other organic chemicals + LITMUS or IU at L2 – say "no change"



Classification of alcohols and haloalkanes (X where X is Cl, Br etc)

- Primary: the -OH (or -Cl) is attached to a C atom that has ONE other C atom attached to it.
- Secondary: the -OH (or -Cl) is attached to a C atom that has TWO other C atoms attached to it.
- Tertiary: the -OH (or -Cl) is attached to a C atom that has THREE other C atoms attached to it.