

Organic Reactions by type

- Substitution
- Addition
- Elimination
- Oxidation
- Acid-base

As you study the different functional groups, and meet the reactions on the following pages tick the boxes

Substitution

An atom is replaced by another atom/group

- The organic product is (still) saturated
 - Two products are made
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Alkanes:

Alkane to Haloalkane

- React with Br₂ or Cl₂. Needs *uv* light and/or heat to occur.
(It doesn't matter which H you substitute in the formula but limit it to just one @ L2).



Haloalkanes:

Haloalkane to Alcohol

- React with KOH(aq), heat.



Haloalkane to Amine

- React with Conc. NH₃(alc)



We do not normally worry about the other product made in these reactions, just the organic product.

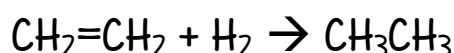
Addition

One bond of the C=C bond breaks and an atom/group adds onto each of the two adjacent C atoms. (Often written as the C=C bond breaks and 2 atoms/groups add on).

- The organic product is saturated
 - One product is made
 - If the alkene is asymmetrical and the reagent is asymmetrical then a major and minor product is made. Remember "rich get richer" where the H is added to the C of the C=C which originally had most H atoms.
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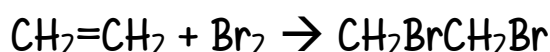
Alkene to Alkane

- H₂, Ni or Pt catalyst



Alkene to Haloalkane

- Br₂ or Cl₂

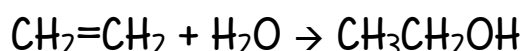


- HBr or HCl



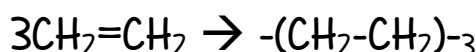
Alkene to Alcohol

- H₂O/H⁺, heat (or dilute acid, heat)



Alkene to (addition) Polymer

- Ethene monomers, heat and catalyst, e.g. 3 repeating units



Elimination

An H atom and an atom/group are removed from two adjacent carbon atoms.

- The organic product is unsaturated / has a C=C
 - Two products are made (but we are interested in the organic one)
 - If the alcohol or haloalkane is asymmetrical then a major and minor product is made. Remember "poor get poorer" where the H is removed from the C atom which originally had least H atoms.
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Alcohol to Alkene

- Conc. H_2SO_4
 $\text{CH}_3\text{CH}_2\text{OH} \rightarrow \text{CH}_2=\text{CH}_2$ (H_2O is removed / dehydration reaction)
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Haloalkane to Alkene

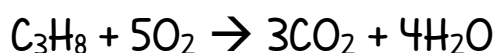
- $\text{KOH}(\text{alc})$, heat
 $\text{CH}_3\text{CH}_2\text{Cl} \rightarrow \text{CH}_2=\text{CH}_2$ (HCl is removed)
 $\text{CH}_3\text{CH}_2\text{Br} \rightarrow \text{CH}_2=\text{CH}_2$ (HBr is removed)
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Oxidation

This group don't look like they have much in common but they all involve an oxidation reaction (reaction with an oxidising agent). There is always an accompanying reduction reaction (so the reactions are REDOX reactions).

Combustion (burning)

- Alkanes, alkenes, alkynes, alcohols etc are all flammable. Any "burning" reaction is an "oxidation" reaction.



Alkene to Diol

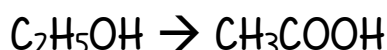
- Uses potassium permanganate, KMnO_4 .
- No heat is needed. The MnO_4^- ion has a purple colour.



- If MnO_4^- with no acid, MnO_4^- is reduced to brown $\text{MnO}_2(\text{s})$
 - If $\text{MnO}_4^-/\text{H}^+$, MnO_4^- is reduced to colourless $\text{Mn}^{2+}(\text{aq})$
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(Primary) Alcohol to Carboxylic Acid

- With $\text{MnO}_4^-/\text{H}^+$, heat (colour change - purple $\text{MnO}_4^-(\text{aq})$ to colourless $\text{Mn}^{2+}(\text{aq})$)
- OR
- With $\text{Cr}_2\text{O}_7^{2-}/\text{H}^+$, heat (colour change - orange $\text{Cr}_2\text{O}_7^{2-}(\text{aq})$ to green $\text{Cr}^{3+}(\text{aq})$)

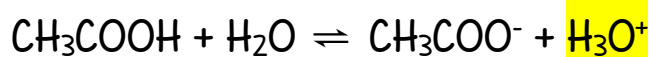


Acid-base

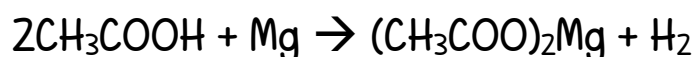
At L2 the only organic acids are carboxylic acids e.g. CH_3COOH AND the only organic bases are amines e.g. $\text{CH}_3\text{CH}_2\text{NH}_2$.

☐ Reactions of Carboxylic Acids

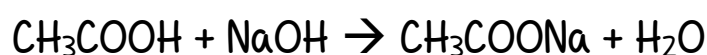
- With H_2O (explaining why carboxylic acids are acidic)



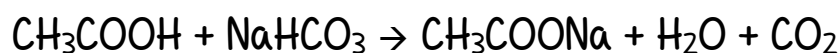
- With Mg (a reactive metal)



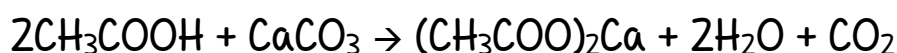
- With NaOH



- With NaHCO_3



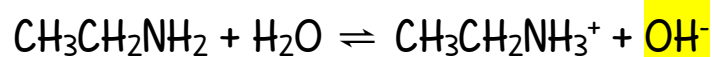
- With Na_2CO_3 (OR with CaCO_3 , marble chips)



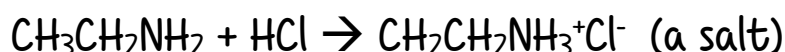
Note: CH_3COONa is often written as $\text{CH}_3\text{COO}^- \text{Na}^+$

☐ Reactions of Amines

- With H_2O (explaining why amines are basic)



- With HCl (acid)



☐ Reaction of Carboxylic Acid and Amine (In 2017 exam; not usually asked!)

- $\text{CH}_3\text{COOH} + \text{CH}_3\text{CH}_2\text{NH}_2 \rightarrow \text{CH}_3\text{CONHCH}_2\text{CH}_3 + \text{H}_2\text{O}$

