Organic reactions

You've already covered 3 types of reactions in organic chemistry

- ✓ cracking
- ✓ -combustion
- ✓ -esterification (dehydration)

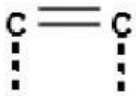
There are many more reactions in organic chemistry

Firstly think back to what saturated and unsaturated meant.

Saturated – when there are only single bonds between carbon atoms

Unsaturated – when there are double of triple bonds between carbon atoms

In other words- with unsaturated compounds, the are not 'full'. If the double or triple bond is broken then there are 2 'new' bonds where something can be added into the molecule.



There are 3 main types of reactions

- Addition
- Elimination
- Substitution

Addition reactions

(molecules go from being unsaturated to being saturated)

During addition reactions, an unsaturated hydrocarbon molecule reacts with

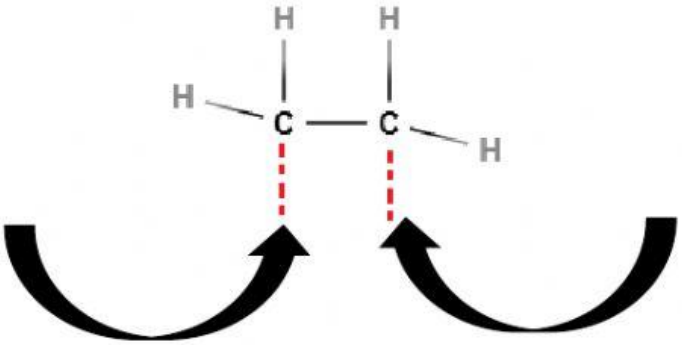
-hydrogen

-halogen

-water

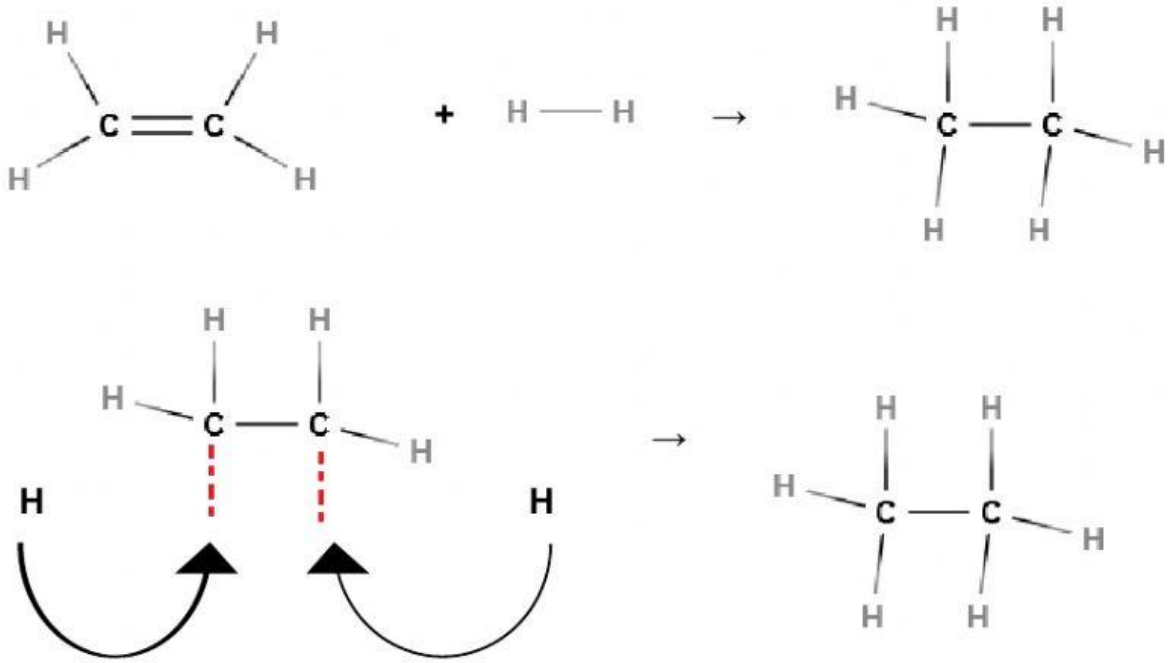
-hydrohalogen (hydrogen and a halogen, eg HCl)

And the double bond breaks and then there is space for two atoms to be added into the molecule



Hydrogenation (adding hydrogen)

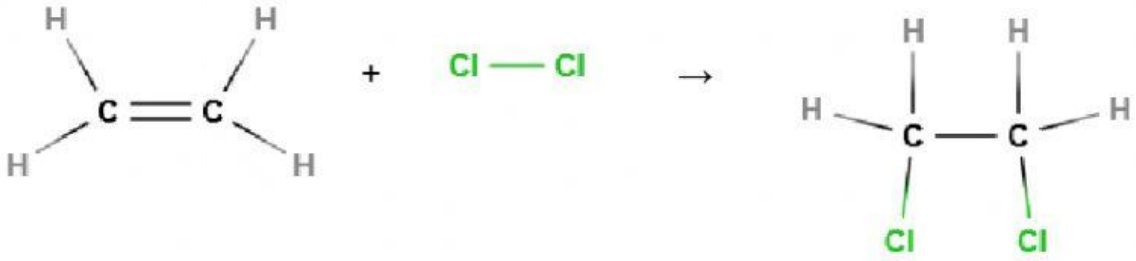
*This reaction happens when vegetable oils are turned into solid fats when margarine is made. (Just look at the back of chip packets – and you'll see *hydrogenated vegetable fat*.) This is an very unhealthier fat, but it is done to increase the shelf life of the product.



The conditions for this reaction are:

- You must use a catalyst of Ni, Pd or Pt
- The alkene must be dissolved in a non-polar solvent
- Must be done in a hydrogen atmosphere (duh)

Halogenation (adding a halogen)

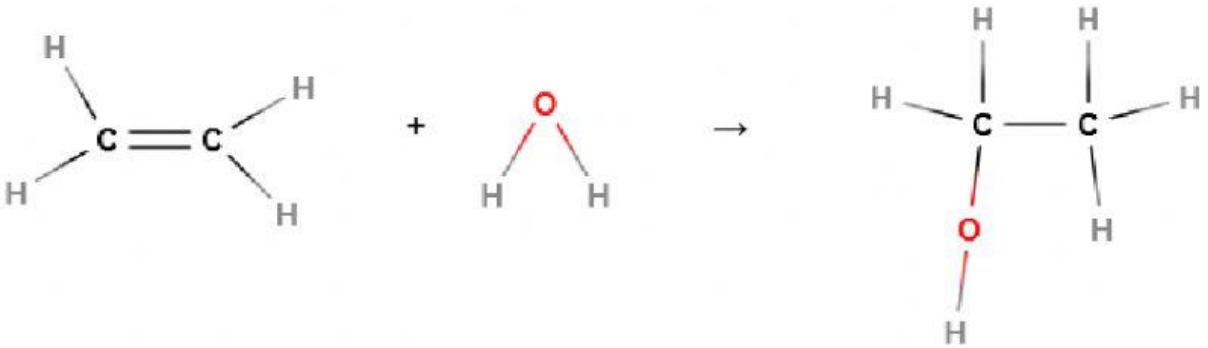


Reaction conditions:

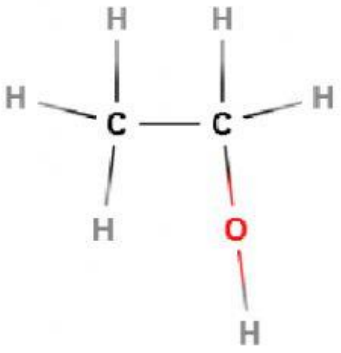
- Alkene must be dissolved in an unreactive solvent

Hydration (adding water)

Firstly the H_2O breaks up into H and OH (so that an alcohol can form)



Or

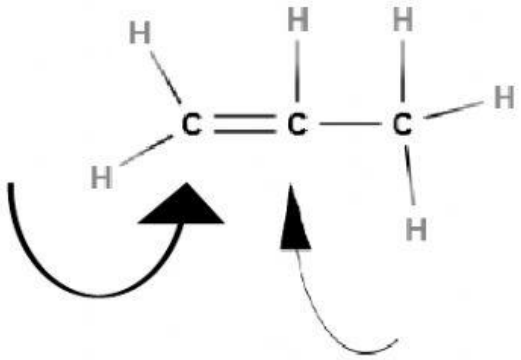


*But remember these two are essentially the same molecule – but just rotated.

So you didn't really have a choice of where to add the H and the OH were added.

But what happens when you do have a choice?

Eg



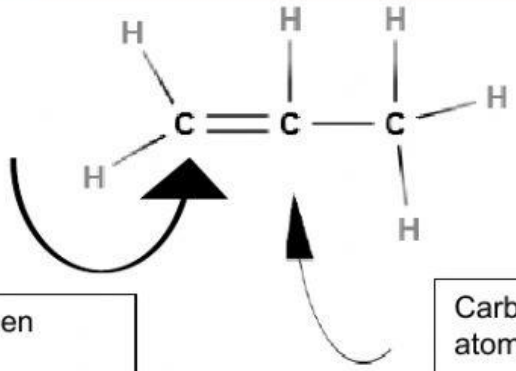
You now have a choice of where to add the OH and the H

Consider the 'more important' OH first

-when you have a choice of where to put the more important OH or Cl etc, then add it to the carbon that has the least number of hydrogens bonded to it in the beginning.

This is called Markovnikov's rule

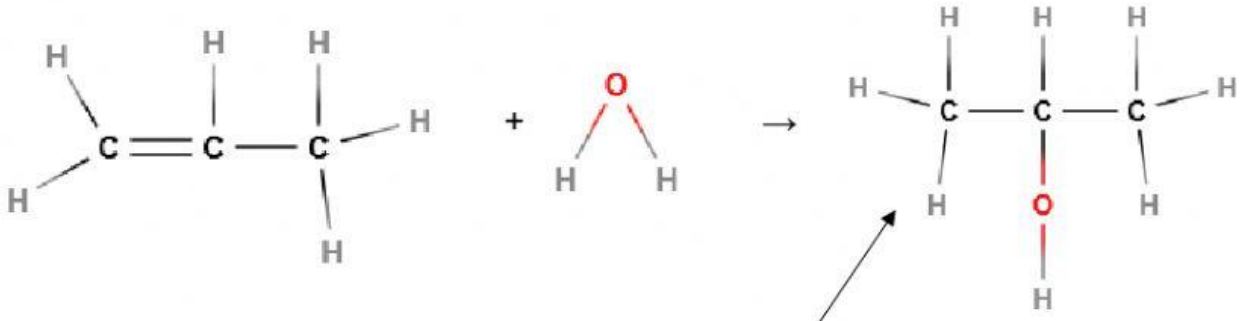
The OH/halogen, when given a choice- is added to the carbon atom with the least number of hydrogen atoms bonded to it.



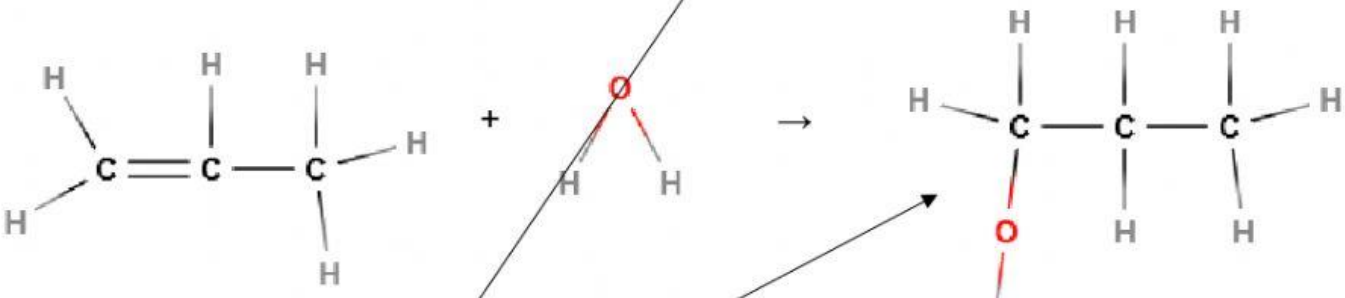
Carbon no 1 - has 2 hydrogen atoms bonded to it

Carbon no 2 – has 1 hydrogen atom bonded to it

Thus the OH from the water will be added to carbon number 2, because it has the least number of Hydrogen atoms bonded to it.



However (there has to be a however, doesn't there) about 10% of the products formed don't follow Markovnikov's rule.



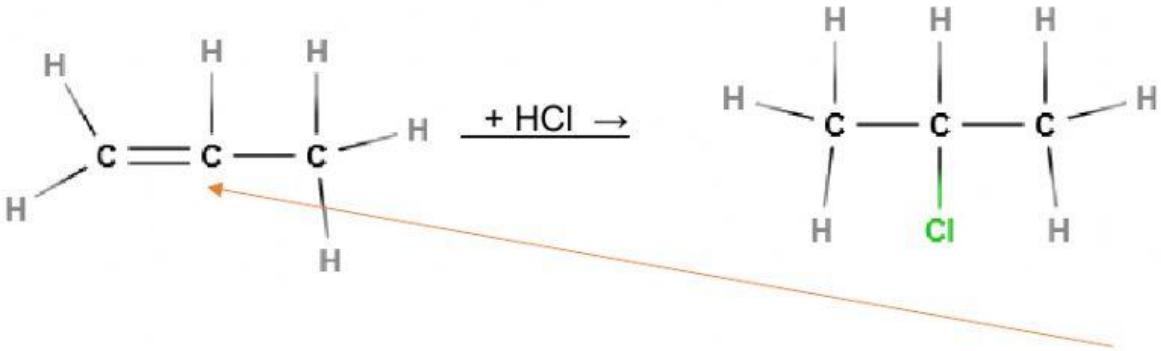
This is called the minor product

This is called the major product

Reaction conditions:

- Catalyst of H_2SO_4/H_3PO_4 used
- Reaction done in excess water

Hydrohalogenation (adding a hydrogen and a halogen)



*remember with Markovnikov's rule – that you need to add the Cl to the carbon that had the least number of hydrogens bonded to it initially.

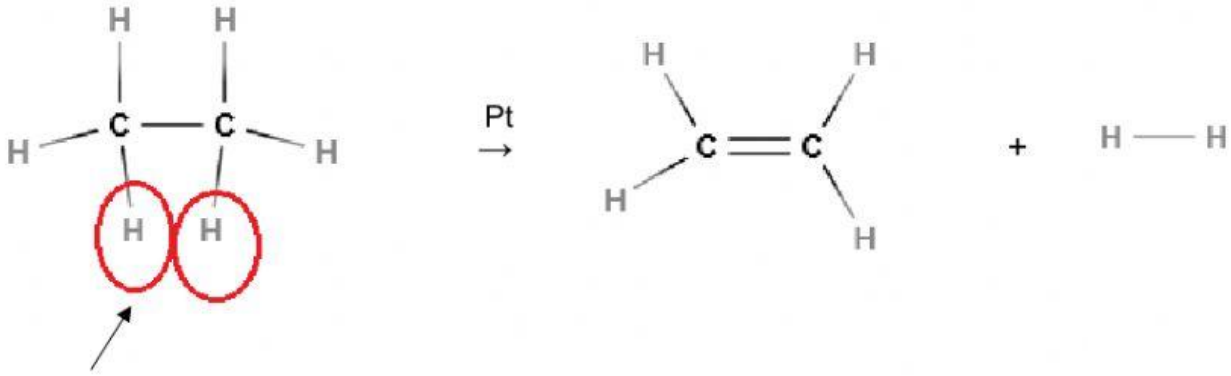
Reaction conditions:

- No water must be present

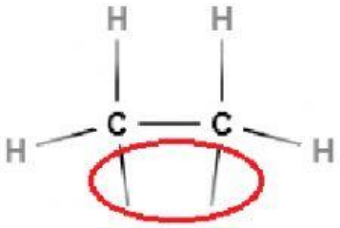
Elimination

(when a saturated organic molecule becomes unsaturated)

Dehydrogenation (removing 2 hydrogens)



These 2 hydrogens get 'eliminated' and 'kicked out' of the compound.

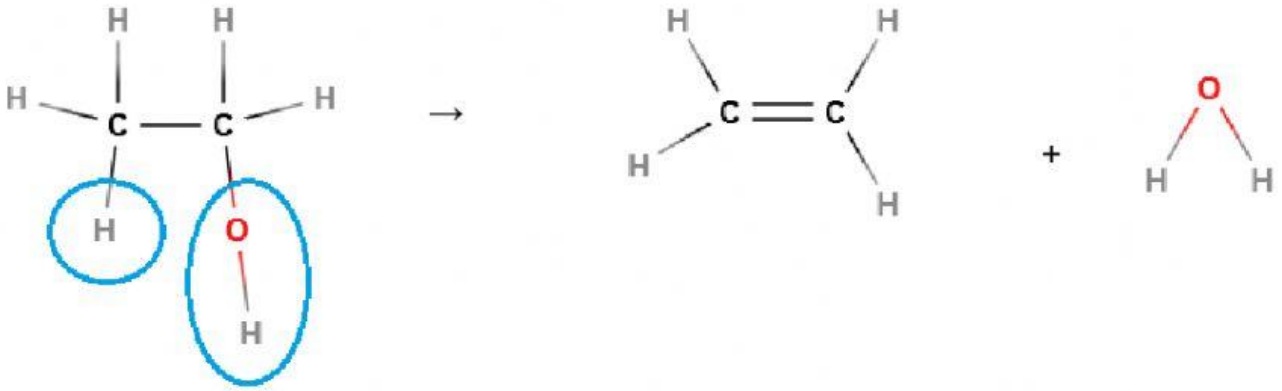


These two bonds now join together and form a double bond

Reaction conditions:

- Pt is added as a catalyst

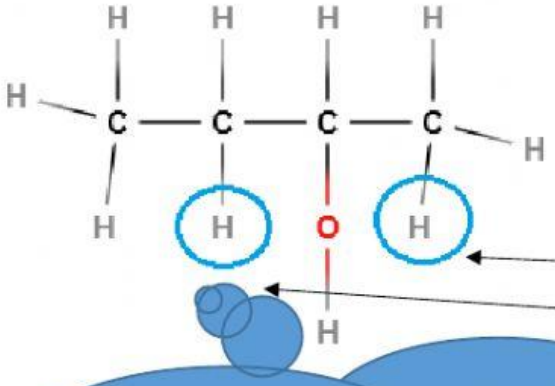
Dehydration (removing of water)



There was no choice of where to remove the OH and the H.

They can't both be removed from the same C.

However let's look at an example where you do have a choice

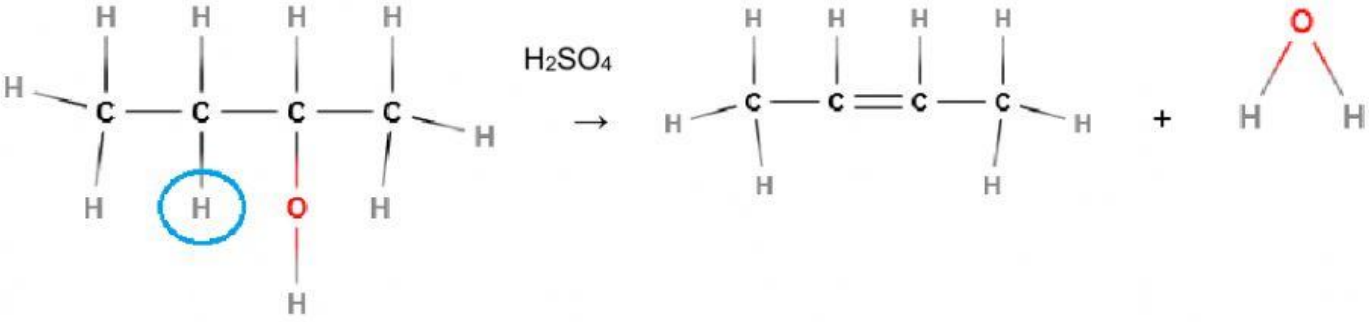


Carbon no 1 contains 3 hydrogens and carbon no 3 contains 2 hydrogens

You have a choice of carbon no 1 or 3 to remove the H from (since the H hast to be removed from a C adjacent to the one with OH on it.)

You apply the same rule as you used before- but this time, to remove the H

Remove the Hydrogen from the Carbon that has the least number of Hydrogens attached to it. Thus carbon no 3 in this case.

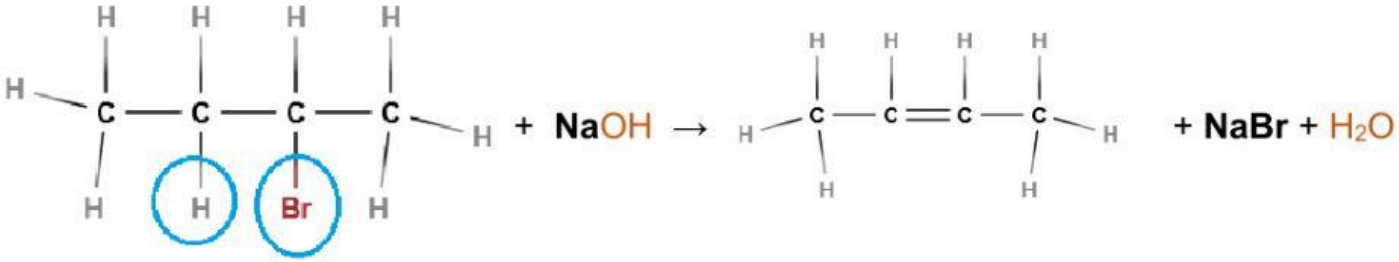


The double bond goes between the two carbons that 'kicked out' the OH and the H

Reaction conditions:

- Use concentrated H2SO4 as a catalyst/dehydrating agent

Dehydrohalogenation (removing of a hydrogen and a halogen)



The **Na** joins with the Br and becomes NaBr

The OH joins with the H and becomes H_2O

Reaction conditions

- The NaOH/(or it can be KOH) needs to be concentrated
- The reaction must be heated under reflux (explained in the video below)

Exercise 1:

1.1 When a substance goes from being unsaturated to saturated, what type of reaction took place:

Addition

Substitution

Elimination

1.2 When a substance goes from being saturated to unsaturated, what type of reaction took place:

Addition

Substitution

Elimination