

Addition reactions

Answer all the questions below as fully as you can then check your answers

1. What is the meaning of the following terms?
 - Unsaturated
 - Saturated
 - Electrophile
 - Nucleophile
 - Sigma (σ) bond
 - Pi (π) bond
 - Carbocation

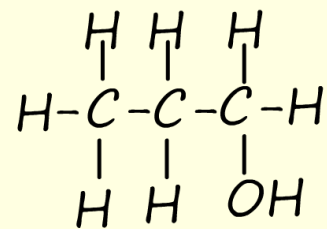
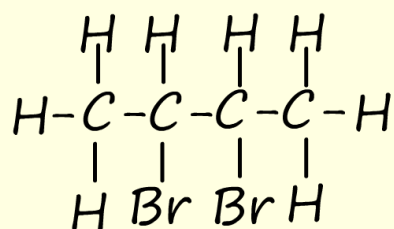
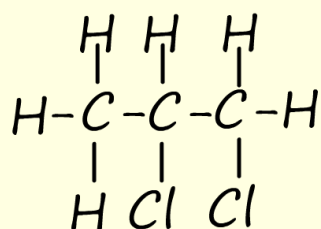
2. Molecules such as bromine and chlorine are non-polar, what does this mean?
 - a. If a molecule is said to have a dipole what does this mean?

 - b. When a chlorine molecule approaches the carbon carbon double bond in an alkene molecule it becomes polarised, explain why this happens.

 - c. What do curly arrows show the movement of? Where should curly arrows start and finish?

 - d. Write an equation using displayed formula to show the mechanism for the addition of chlorine (Cl_2) to a molecule of ethene (C_2H_4).

3. Describe the test for unsaturation in a molecule.
- a. Write an equation to show the products of the reaction when ethene is bubbled through bromine water.
- b. Explain how the results of this test are different if ethene or an alkene is bubbled through a bromine solution formed when the bromine is dissolved in an organic solvent such as hexane.
4. Name the molecules below and suggest how they could be made using an addition reaction.



Answers

1. What is the meaning of the following terms?
 - Unsaturated - contains $C=C$ or $C\equiv C$
 - Saturated - contains $C-C$ bonds and no double or triple bonds between the carbon atoms.
 - Electrophile - electron deficient species, they react by accepting a pair of electrons, they are attracted to areas of high electron density such as found in a pi bond in a $C=C$.
 - Nucleophile - electron rich species, they bond with electrophiles by donating a pair of electrons.
 - Sigma bond (σ) - formed by head-on overlap of atomic orbitals in a covalent bond.
 - Pi (π) bond - formed by side-ways or partial overlap of atomic orbitals in a covalent bond.
 - Carbocation - carbon atom with a positive charge, C^+ , also called a carbonium ion.

2. Molecules such as bromine and chlorine are non-polar, what does this mean?

The bonding between the molecules is covalent which means that the electron density between the two bonding atoms is EQUALLY shared.

 - a. If a molecule is said to have a dipole what does this mean?

The molecule has charged ends, δ^+ and δ^- ends or an uneven electron distribution between the atoms involved in forming the bonds within the molecule.

 - b. When a chlorine molecule approaches the carbon carbon double bond in an alkene molecule it becomes polarised, explain why this happens.

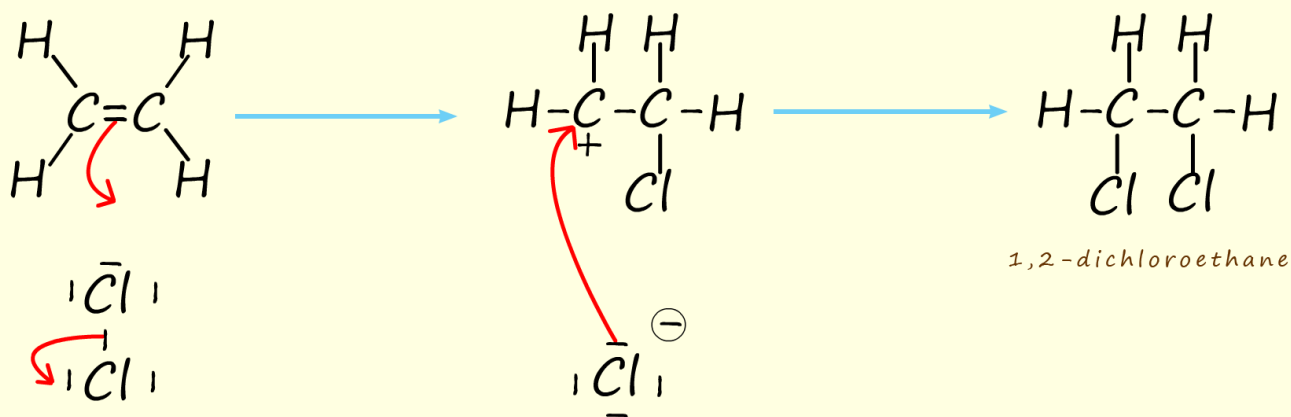
The electron density within a chlorine atom in the chlorine molecule is repelled as it approached the pi (π) electrons in the $C=C$.

- c. What do curly arrows show the movement of? Where should curly arrows start and finish?

Curly arrows show the movement of a pair of electrons. They should start on a lone pair or in the middle of a bond.

They should end up on an atom if they starting in the middle of a covalent bond or if starting on a lone pair or a C=C they can end up half way between the two atoms involved in forming the new bond.

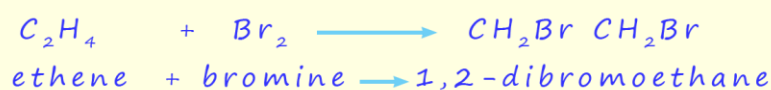
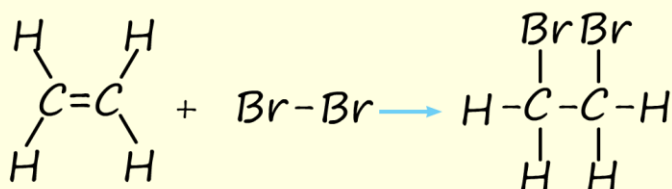
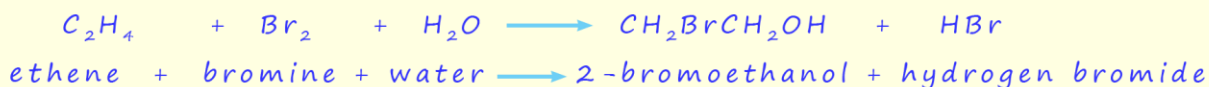
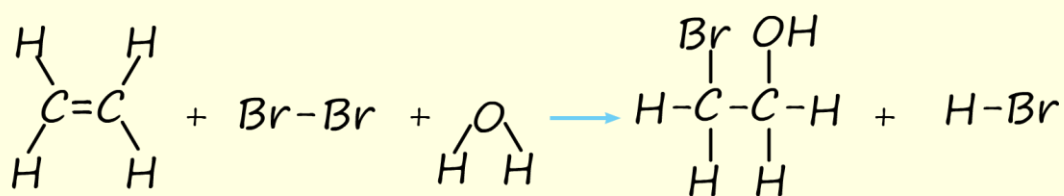
- d. Write an equation using displayed formula to show the mechanism for the addition of chlorine (Cl_2) to a molecule of ethene (C_2H_4).



3. Describe the test for unsaturation in a molecule.

A few drops of the compound under test are added to a test-tube of bromine water and shaken. If the bromine water decolourises immediately this indicates the presence of unsaturation within the compound.

- a. Write an equation to show the products of the reaction when ethene is bubbled through bromine water. The first equation is the reaction of ethene with bromine water. The second equation is the reaction with bromine in an organic solvent.

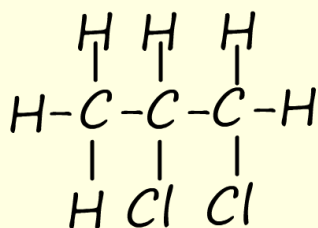


- b. Explain how the results of this test are different if ethene or an alkene is bubbled through a bromine solution formed when the bromine is dissolved in an organic solvent such as hexane.

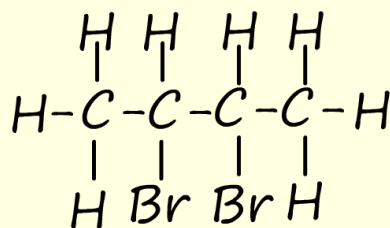
Using bromine water results in the formation of a bromoalcohol.

Using bromine in an organic solvent results in the formation of a dibromoalkane.

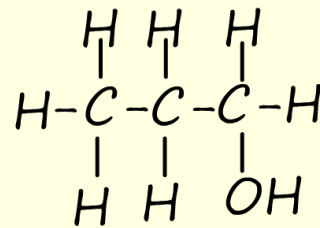
4. Name the molecules below and suggest how they could be made using an addition reaction.



1,2-dichloropropane



2,3-dibromobutane



propan-1-ol

1. 1,2-dichloropropane - addition of chlorine to propene
2. Addition of bromine to butene, reaction carried out in an organic solvent such as hexane.
3. Addition of water to propene - could be done by direct hydration or using concentrated sulfuric acid and propene followed by hydrolysis would yield mixture of propan-1-ol and propan-2-ol.