10.1: Introduction

This is an introductory page about alkenes such as ethene, propene and the rest. It deals with their formulae and isomerism, their physical properties, and an introduction to their chemical reactivity.

What are alkenes?

Alkenes are a family of hydrocarbons (compounds containing carbon and hydrogen only) containing a carbon-carbon double bond. The first two are:

ethene	C_2H_4
propene	C_3H_6

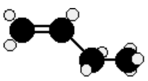
You can work out the formula of any of them using: C_nH_{2n} The table is limited to the first two, because after that there are isomers which affect the names.

Isomerism in the alkenes

Structural isomerism

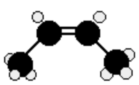
All the alkenes with 4 or more carbon atoms in them show structural isomerism. This means that there are two or more different structural formulae that you can draw for each molecular formula.

For example, with C_4H_8, it isn't too difficult to come up with these three structural isomers:



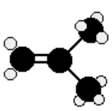
$CH_2{=}CH{-}CH_2{-}CH_3$

but-1-ene



$CH_3{-}CH{=}CH{-}CH_3$

but-2-ene



CH_3
$CH_2{=}C$
CH_3

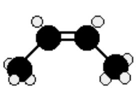
2-methylpropene

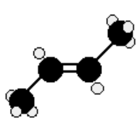
There is, however, another isomer. But-2-ene also exhibits geometric isomerism.

Geometric (cis-trans) isomerism

The carbon-carbon double bond doesn't allow any rotation about it. That means that it is possible to have the CH_3 groups on either end of the molecule locked either on one side of the molecule or opposite each other.

These are called cis-but-2-ene (where the groups are on the same side) or trans-but-2-ene (where they are on opposite sides).





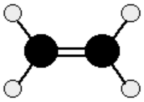
cis-but-2-ene trans-but-2-ene

Cis-but-2-ene is also known as (Z)-but-2-ene; trans-but-2-ene is also known as (E)-but-2-ene. For an explanation of the two ways of naming these two compounds, follow the link in the box below..

Chemical Reactivity

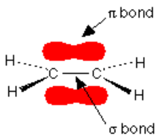
Bonding in the alkenes

We just need to look at ethene, because what is true of C=C in ethene will be equally true of C=C in more complicated alkenes. Ethene is often modeled like this:



The double bond between the carbon atoms is, of course, two pairs of shared electrons. What the diagram doesn't show is that the two pairs aren't the same as each other.

One of the pairs of electrons is held on the line between the two carbon nuclei as you would expect, but the other is held in a molecular orbital above and below the plane of the molecule. A molecular orbital is a region of space within the molecule where there is a high probability of finding a particular pair of electrons.



In this diagram, the line between the two carbon atoms represents a normal bond - the pair of shared electrons lies in a molecular orbital on the line between the two nuclei where you would expect them to be. This sort of bond is called a sigma bond.

The other pair of electrons is found somewhere in the shaded part above and below the plane of the molecule. This bond is called a pi bond. The electrons in the pi bond are free to move around anywhere in this shaded region and can move freely from one half to the other.

The pi electrons are not as fully under the control of the carbon nuclei as the electrons in the sigma bond and, because they lie exposed above and below the rest of the molecule, they are relatively open to attack by other things.

Contributors

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