

Topic: Organic Chemistry

1.1 Alkenes

Writing extended definitions

- A. Read the following excerpt and using information from the text write an extended definition of alkenes (not more than 90 words). Remember to use your own words!**

Excerpt 1

Alkenes are hydrocarbons that contain a carbon-carbon double bond. The word *olefin* is often used as a synonym, but alkene is the generally preferred term. Alkenes occur abundantly in nature. Ethylene, for example, is a plant hormone that induces ripening in fruit, and α -pinene is the major component of turpentine. Life itself would be impossible without such alkenes as β -carotene, a compound that contains 11 double bonds. An orange pigment responsible for the color of carrots, β -carotene, a compound that contains 11 double bonds. An orange pigment responsible for the color of carrots β -carotene serves as a valuable dietary source of vitamin A and is thought to offer some protection against certain types of cancer (1, pp. 188-89).

Because they contain fewer hydrogens than alkanes with the same number of carbons, alkenes and alkynes are said to be unsaturated. Rotation around the double bond is restricted, and substituted alkenes can therefore exist as cis-trans stereoisomers. The geometry of a double bond can be specified by application of the Cahn-Ingold-Prelog sequence rules, which assign priorities to double-bond substituents. If the high-priority groups on each carbon are on the same side of the double bond, the geometry is *Z* (*zusammen*, "together"); if the high-priority groups on each carbon are on opposite sides of the double bond, the geometry is *E* (*entgegen*, "apart").

Alkene chemistry is dominated by electrophilic addition reactions. When HX reacts with an unsymmetrically substituted alkene, Markovnikov's rule predicts that the H will add to the carbon having fewer alkyl substituents and the X group will add to the carbon having more alkyl substituents. Electrophilic additions to alkenes take place through carbocation intermediates formed by reaction of the nucleophilic alkene π bond with electrophilic H⁺. Markovnikov's rule can be restated by saying that, in the addition of HX to an alkene, the more stable carbocation intermediate is formed. This result is explained by the Hammond postulate, which says that the transition state of an exergonic reaction step structurally resembles the reactant, whereas the transition state of an endergonic reaction step structurally resembles the product. Since an alkene protonation step is endergonic, the stability of the more highly substituted carbocation is reflected in the stability of the transition state leading to its formation.

Evidence in support of a carbocation mechanism for electrophilic additions comes from the observation that structural rearrangements often take place during reaction. Rearrangements occur by shift of either a hydride ion, :H⁻ (a hydride shift), or an alkyl anion, :R⁻, from a carbon atom to the adjacent positively charged carbon. The result is isomerization of a less stable carbocation to a more stable one (1, pp. 222-23).