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Alkene Definition and Classification Alkenes, also known as olefins, are hydrocarbons containing one or more carbon-carbon double bonds. This double bond may be internal or at the terminal position, and it distinguishes them from alkanes and alkynes. **Classification:** * The International Union of Pure and Applied Chemistry (IUPAC) recommends using specific names for different types of alkenes: + Acyclic hydrocarbons with one double bond: alkene + Acyclic hydrocarbons with two or more double bonds: polyene + Cyclic ones: cycloalkene, cycloalkadiene, etc. * The general term "olefin" is used for cyclic or acyclic alkenes with one or more double bonds. **Properties:** * Alkenes are generally colorless and non-polar compounds, similar to alkanes but more reactive. * They exhibit a homologous series of hydrocarbons with the formula CnH2n, where n is a natural number greater than 1. * The simplest alkene, ethylene, is produced on the largest scale industrially. **Structural Isomers:** * Alkenes can form diverse structural isomers, especially when they have four or more carbon atoms. * Many of these molecules exhibit cis-trans isomerism and may have chiral carbon atoms. The formation of sigma bonds to three atoms in a hybrid orbital creates a stable structure. The remaining unhybridized 2p atomic orbitals combine to form a pi bond outside the main axis, resulting in a weaker bond (65 kcal/mol). This leads to restricted rotation around the double bond, making cis or trans isomers interconvert slowly and allowing them to be handled freely at ambient conditions without isomerization. Alkenes with three or four different substituents can be named using the E–Z notation, which distinguishes between molecules with functional groups on the same side or opposite sides of the double bond. The molecular geometry of alkenes includes bond angles around each carbon atom in a double bond of approximately 120°, but these angles may vary due to steric strain from nonbonded interactions. Bredt's rule states that a double bond cannot occur at the bridgehead of a bridged ring system unless the rings are large enough. The cis- and trans- configurations are used to describe the positions of functional groups attached to carbon atoms joined by a double bond, with the former indicating the same side and the latter indicating opposite sides. Most alkenes have similar physical properties such as being colorless and nonpolar, however they do burn easily. The boiling point of alkenes typically varies depending on the molecular mass with lower masses like ethylene, propylene, and butene existing as gases at room temperature while higher alkenes are waxy solids. On average, alkenes have stronger smells compared to their saturated counterparts like ethane. Certain strained alkenes like norbornene have potent odors due to the formation of strong π complexes with metal ions. Alkenes undergo combustion releasing less energy than their saturated equivalents. Various physical properties including melting and boiling points can be found in a list below: * Number of carbons: 2-5 * Name: ethane, ethylene, acetylene * Melting point (°C): -183, -169, -80.7 * Boiling point (°C): -89, -104, -84.7 Reactivity is higher in alkenes compared to alkanes as a result of their relatively unstable nature. The formation of new single bonds in alkenes enables them to participate in various reactions, such as polymerization and alkylation, making them an essential feedstock for the petrochemical industry. Alkenes have two sites of reactivity: the carbon-carbon pi-bond and allylic CH centers, with the former dominating but the latter being important too. Hydrogenation involves the addition of H2 to form an alkane, while halogenation adds a halogen molecule, resulting in a dihaloalkane. The bromine test is used to determine the saturation of hydrocarbons and can also indicate the degree of unsaturation for unsaturated hydrocarbons. The reaction rate depends on the number of pi bonds. Hydration involves strong acid as a catalyst, forming a carbocation which then results in an alcohol. Hydrohalogenation adds H−X to unsaturated hydrocarbons, resulting in new C−H and C−X σ bonds. Alkenes undergo Diels-Alder reactions with dienes to form cyclohexenes, retaining stereochemistry. They also dimerize under UV-light to form cyclobutanes. Additionally, alkenes react with percarboxylic acids and hydrogen peroxide to yield epoxides. The industrial scale epoxidation of ethylene using oxygen in the presence of silver-based catalysts is a notable example. Alkenes can undergo various transformations with oxidizing agents such as KMnO4, which cleave them into ketones and carboxylic acids. This reaction can be controlled by choosing specific conditions to yield a range of products. For instance, using osmium tetroxide or other oxidants allows the oxidation to stop at the vicinal diol stage rather than full cleavage. Additionally, alkenes can undergo reactions with reactive oxygen species generated by photosensitizers like methylene blue and light. These alternative processes include Type I reactions involving electron transfer from a reducing substrate, as well as Type II reactions where interaction occurs between the sensitizer and oxygen. Choice of reaction conditions allows for control over these various processes, leading to different products. In contrast to ozonolysis, some transformations yield cyclic compounds such as endoperoxides. These reactions can be used to determine the position of a double bond in an unknown alkene. Conjugated dienes like buta-1,3-diene and isoprene also undergo polymerization under certain conditions. Furthermore, alkenes exhibit high reactivity due to their weakened allylic C-H bonds, making them susceptible to free radical substitution at these sites as well as addition reactions at the C=C site. The presence of two adjacent double bonds flanking a methylene group results in particularly weak HC-H bonds, which is exploited in certain free radical reactions. Lastly, alkenes can undergo olefin metathesis, where their substituents are cleaved and interchanged, while related reactions such as ethenolysis lead to the formation of different products. The metal d orbitals play a crucial role in the donation and back bonding process, affecting the bond order and C-C bond length of alkenes. The stronger the donation, the weaker the alkene's π* anti-bonding orbital, leading to an increase in bond length and a decrease in bond order. This is exemplified by the complex PtCl3(C2H4)], which relates to metal-catalyzed reactions of unsaturated hydrocarbons. These reactions include various processes such as hydrogenation, hydroalkenylation, halogen addition, and hydroformylation, each with distinct mechanisms and outcomes. The reaction names are accompanied by comments on the products formed and the conditions under which they occur. The production of alkenes is a key aspect of hydrocarbon cracking, where alkanes are broken apart at high temperatures to produce a mixture of primarily aliphatic alkenes and lower molecular weight alkanes. This process is mainly used for the manufacture of small alkenes up to six carbons. Catalytic dehydrogenation, related to this process, involves an alkane losing hydrogen to produce a corresponding alkene, which is the reverse of catalytic hydrogenation. Alkenes can also be formed through a nickel, cobalt, or platinum-catalyzed reaction between ethylene and triethylaluminium. In laboratory settings, a primary method for synthesizing alkenes involves the elimination reaction of alkyl halides, alcohols, and similar compounds, often via the β-elimination E2 or E1 mechanism. Notably, vinyl chloride production relies on this process. The E2 mechanism generally offers a more dependable β-elimination approach than E1 for most alkene syntheses, commonly initiating with an alkyl halide or alkyl sulfonate ester (e.g., tosylate or triflate), a process known as dehydrohalogenation when starting with an alkyl halide. For unsymmetrical products, Zaitsev's rule often prevails, favoring more substituted alkenes. Key elimination reactions include the dehydrohalogenation of alkyl halides and the dehydration of alcohols. A typical example illustrates the anti-orientation of H to the leaving group, even when yielding the less stable Z-isomer. Alcohols can also be converted into alkenes through dehydration (via the E1 mechanism), as seen in ethanol's conversion to ethylene: CH3CH2OH → H2C=CH2 + H2O. Enhancing the leaving group (e.g., to xanthate) facilitates milder syn-eliminations, such as the Chugaev or Grieco eliminations. Related reactions encompass the Boord olefin synthesis (β-haloethers' eliminations) and ester pyrolysis. The Corey-Winter olefination combines thioketones with phosphite esters to deoxygenate glycols into alkenes, while diphosphorus tetraiodide achieves similar results. Indirectly, alkenes can be prepared from alkyl amines by first modifying the amine group (e.g., via Hofmann elimination or Cope reaction) to enable smooth elimination, as exemplified in cyclooctene's synthesis via Cope elimination. Notably, the Hofmann elimination uniquely favors the less substituted (non-Zaitsev) alkene. The Ramberg–Bäcklund reaction generates alkenes from α-halosulfones through a three-membered ring sulfone intermediate. Another crucial approach involves creating a new carbon-carbon double bond by coupling or condensing carbonyl compounds with carbanions or equivalents, prominently featuring the aldol condensation and Knoevenagel condensations (collectively known as olefinations). The Wittig reaction exemplifies this, involving an aldehyde or ketone reacting with a Ph3P=CHR Wittig reagent to yield an alkene and Ph3P=O. This reagent is readily prepared from triphenylphosphine and an alkyl halide. 1,3-Butadiene is a key precursor for synthetic rubber and vinyl chloride, while styrene is used to produce polystyrene. Alkenes are abundant in nature, primarily sourced from plants as terpenes. These compounds can be found in various natural pigments, such as lycopene and carotene, and also serve as signaling molecules in plant ripening. The Curiosity rover discovered long-chain alkanes on Mars, which could be of either abiotic or biological origin. Unsaturated compounds like limonene, humulene, and taxadiene are found in nature, with taxadiene serving as a precursor to the anticancer agent taxol. Squalene is a triterpene that serves as a universal precursor for natural steroids. Cis-trans isomerism occurs when two carbons in a double bond have different atoms or groups attached to them. To accommodate these cases, the IUPAC recommends using the E-Z notation instead of the cis and trans prefixes. This notation takes into account the group with the highest priority at each carbon atom and labels it as either E (meaning "opposite") if the groups are on opposite sides of the double bond's plane or Z (meaning "together") if they are on the same side. The IUPAC also recognizes two names for hydrocarbon groups containing carbon-carbon double bonds: vinyl and allyl. The difference between E and Z isomers can be understood using mnemonic devices such as "Z means 'on ze zame zide'". Additionally, the IUPAC has established several rules and guidelines for naming unsaturated compounds and radicals, including the Bredt's Rule, which states that a double bond in an aromatic ring cannot have an atom or group attached to it. The physical and chemical properties of alkenes have been extensively studied. Research has shown that the boiling points and structures of hydrocarbons, including alkenes, are closely related (1). The nuclear magnetic resonance (NMR) spectra of alkenes can provide valuable information about their molecular structure (2-4). Additionally, the bromine number of an alkene can be used to determine its degree of unsaturation (5). The acid-catalyzed hydration of ethene is a well-studied reaction that involves the formation of an alkene intermediate (6). Advanced organic chemistry textbooks, such as those by Smith and March, provide detailed discussions of alkene reactions and mechanisms (7). Photochemical reactions involving alkenes have also been investigated, including type I and type II photosensitized oxidation reactions (8). Organotransition metal complexes with alkenes have been studied in detail, and these complexes play a crucial role in catalytic reactions such as metathesis (9-12). The elimination reactions of alkenes have been extensively studied, including the E2 reaction, which involves the removal of a leaving group and a beta-hydrogen atom (13-15). The Cope elimination reaction is another important reaction that involves the formation of an alkene intermediate (16). Alkene-forming condensation reactions, such as the Wittig reaction, are also widely used in organic synthesis (17). Finally, metathesis reactions, which involve the exchange of alkylidene groups between two alkenes, have been extensively studied and have many applications in organic chemistry (18-19). References: (1) Nguyen et al. (2019) (2) Ophardt (2003) (3) Hanson (n.d.) (4) Chemistry LibreTexts (2019) (5) Hach company (n.d.) (6) Clark (2007) (7) Smith and March (2007) (8) Baptista et al. (2017) (9) Hartwig (2010) (10) Toreki (2015) (11) Wade (2006) (12) Saunders (1964) (13) Cram et al. (1956) (14) Bach et al. (1973) (15) Crowell (1964) (16) Delaude and Noels (2005) (17) Vogt (2010) Note: The references provided are a selection of the original sources cited in the text, and are not an exhaustive list of all the references mentioned. But-1-ene, also known as 1-butylene or ethylethylene, is an organic compound with the formula CH3CH2CH=CH2. It is a colorless gas that can be easily condensed into a liquid. As a linear alpha-olefin (terminal alkene), it is one of the isomers of butene (butylene). But-1-ene has various applications, including polymerization to produce polybutylene for plumbing and as a comonomer in the production of certain types of polyethylene, such as linear low-density polyethylene (LLDPE). It can also be used as a precursor to polypropylene resins, butylene oxide, and butanone. The compound is produced through separation from crude C4 refinery streams. (Note: I've kept the original text's structure and highlighted the main points, while rephrasing it in simpler language.) 1-butene, a type of alkene, can be produced through ethylene dimerization and other processes. The resulting mixture contains a combination of 1-butene and its isomer, 2-butene. To obtain high-purity 1-butene, distillation is employed. According to estimates, around 12 billion kilograms of 1-butene were produced in 2011. The chemical properties and uses of 1-butene are documented in various sources, including the IUPAC Blue Book and Ullmann's Encyclopedia of Industrial Chemistry. The compound has applications in polyolefin production and is also used as a precursor for other chemicals. **Understanding Alkenes** Alkenes are a type of unsaturated hydrocarbon found in crude oils that contains at least one double bond between carbon-carbon atoms. This makes them more reactive than saturated hydrocarbons, such as alkanes. In this article, we will explore the properties and characteristics of alkenes. **Key Features of Alkenes** * Unsaturated hydrocarbons with a double bond between carbon-carbon atoms * General formula: CnH2n * Also known as olefins, derived from the Greek word "olefin gas," meaning oil-forming **Relevance and Uses of Alkenes** Alkenes are an important family of hydrocarbons that play a significant role in various industrial applications. Their reactivity makes them useful for producing a wide range of chemicals and materials. Note: I removed the list of links, special pages, and Wikipedia logs as they are not relevant to the main content of the article. Alkenes are highly reactive chemicals with the general formula CnH2n, where n ranges from 2 to infinity. According to IUPAC rules, alkenes have suffix-ene names and prefixes based on the number of carbon atoms. Examples include ethene (C2H4), propene (C3H6), butene (C4H8), pentene (C5H10), hexene (C6H12), heptene (C7H14), octene (C8H16), nonene (C9H18), and decene (C10H20). Alkenes can exhibit structural isomerism, stereoisomerism, and chain and position isomerism. Structural isomerism refers to the difference in arrangement of atoms or groups around a double bond, while stereoisomerism refers to the relative spatial arrangement of these atoms or groups. Chain isomerism involves changes to the position of the double bond without altering its structure, whereas position isomerism involves differences in the placement of the double bond. Geometrical isomers occur when the same structural formula has different spatial arrangements around a double bond, leading to cis- and trans-isomers. There are several methods for preparing alkenes: 1. Partial reduction of alkynes: Alkynes can be reduced with hydrogen in the presence of palladized charcoal to produce alkenes. 2. Dehydrogenation of alkyl halides: Strong bases such as sodium ethoxide or potassium hydroxide can dehydrate alkyl halides, producing alkenes. 3. Heating vicinal halides: Dihalogen derivatives of alkanes can be heated with zinc dust to produce alkenes. 4. Elimination of alcohols: Alcohols can eliminate water molecules in the presence of mineral acids, such as sulfuric acid, producing alkenes. Some specific examples include preparing ethylene from ethyl alcohol and sulfuric acid at 440 K. Alkenes, also known as unsaturated hydrocarbons, have unique properties and uses. The first three members (ethene, propene, butene) are colorless gases with no distinct smell or color, while higher members are liquids or solids. Alkenes are insoluble in water but soluble in non-polar solvents like benzene. Alkenes can undergo various reactions, including: * Addition of hydrogen to form alkanes * Reaction with halogens to form halogen derivatives * Reaction with halogen halides to form alkyl halides * Polymerization to form compounds like polythene, PVC, Teflon, and orlon. Alkenes have various uses in industry and everyday life: * Artificial ripening of fruits * Manufacture of ethyl alcohol and ethylene glycol * Production of anti-knock fluids for car engines * Use in making oxygen-ethylene flame for cutting and welding The first ten alkenes are listed, along with their chemical formulas. This paraphrased text aims to preserve the main points and ideas of the original text while presenting them in a new and concise format. alkenes are colorless and odorless gases or liquids, insoluble in water but soluble in non-polar solvents, their boiling points increase with molecular mass, straight-chain alkenes have higher boiling points than branched chain isomeric ones, alkenes are highly reactive due to double bonds between carbon atoms, the general formula for alkenes is CnH2n, used in polymerization to produce polythene PVC Teflon onlon and artificial ripening of fruits

First 10 alkenes list. What are the 10 examples of alkenes. What are the 10 alkenes with structural formula. What are the first 10 alkenes. What are the 10 properties of alkenes. What are the first 10 alkenes structural formula. What are the first 20 alkenes. What are the 10 uses of alkenes. 6.1 alkanen en alkenen.