I'm not a robot



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Unsaturated molecules such as alkenes readily undergo addition reactions. You may recall from your gose science lessons that small molecules can "add" across the carbon double bond (C=C) in alkenes to form new saturated molecules can "add" across the carbon double bond (C=C) in alkenes to form new saturated molecules.
addition reactions were discussed on the page covering simple addition of hydrogen halides are all gases at room temperature; they
include hydrogen chloride (HCl), hydrogen bromide (HBr) and hydrogen in the electronegativity values between hydrogen and the halogens atom in the molecule. This aids in an easy addition reaction in the gas phase with the carbon carbon
double bond (C=C) in an unsaturated alkene molecule. This reaction produces halogenalkanes; a mechanism for the gas phase reaction will occur with hydrogen bromide gas with the alkene ethene is shown below, though a similar reaction will occur with hydrogen bromide gas with the alkene molecule. This reaction produces halogenalkanes; a mechanism for the gas phase reaction will occur with hydrogen bromide gas with the alkene molecule. This is a typical electrophilic addition reaction. The mechanism for
the addition of hydrogen bromide gas to ethene- a typical electrophile, while the negatively charged bromide ion acts as a nucleophile when it attacks the intermediate carbocation.
Hydrogen chloride, bromide and iodide are all acidic gases and will readily dissolve in water to form acidic solutions, so if the reaction with an alkene is carried out in aqueous conditions rather than in the gas phase then the hydrogen ion (H+) from the acidic solution will act as the electrophile and the halide ion will act as the nucleophile and attack
the intermediate carbocation to produce the halogenalkane. The relative reactivity in these electrophilic additions reaction is HI > HBr > HCl. This mirrors the stronger acid than hydrochloric acid. 2. Preparation of alcohols using alkenes There are
numerous methods of preparing alcohols from alkenes. One method which is often used in industry is called direct hydration. This involves adding a molecule of water across the carbon double bond (C=C) in an alkene to produce an alcohol. This method requires a phosphoric acid (H3PO4) catalyst, a high temperature (570K) and a high
pressure (65 atmospheres). The mechanism for this reaction is shown below. The mechanism is similar to the other electrophilic addition of the H+ ion to the C=C. Step 2: Nucleophilic attack by a water molecule using one of its lone pairs of electrons on the intermediate
carbocation. Loss of a proton (H+) to produce the alcohol and also regenerate the acid catalyst. We can show this direct hydration using the following equations: 3. Alkenes and sulfuric acid with an alkene. The mechanism for this reaction is shown below; hopefully you will
notice it is very similar to previous reactions of alkenes that we have seen above. The reaction proceeds as shown below: Electrophilic addition of the hydrogensulfate ion (HSO4-) to the intermediate carbocation. The final step in this reaction is hydrolysis of
the ethyl hydrogensulfate using dilute sulfuric acid to produce the alcohol and regenerate the sulfuric acid catalyst. The diols are a family of alcohols which contain two hydroxyl functional groups (R-OH) per molecule. Perhaps the most widely used diol is ethane-1,2-diol (CH2OHCH2OH) which is used as antifreeze and as a coolant in car engines.
Alkenes can be oxidised to form 1,2-diols using cold dilute solutions of potassium permanganate as an oxidising agent. The permanganate ion (MnO4-) is a powerful oxidising agent due to the fact that the central manganese atom has an oxidising agent due to the fact that the central manganese atom has an oxidising agent.
the alkene to form the diol. The permanganate ion forms a purple solution when dissolved in water and when it is used to oxidise an alkene the colour changes observed during the reaction depend on whether the reaction is carried out in acidified
solution of the permanganate ion (MnO4-) then the purple permanganate ion is reduced to form the pale pink Mn2+ ion, which is so pale as to be almost colourless, while the alkene is oxidised to form the purple permanganate ion (MnO4-) then the purple permanganate ion is reduced to form the pale pink Mn2+ ion, which is so pale as to be almost colourless, while the alkene is oxidised to form the purple permanganate ion (MnO4-) then the purple permanganate ion is reduced to form the purple permanganate ion (MnO4-) then the purple permanganate ion (MnO4-) then the purple permanganate ion (MnO4-) then the purple permanganate ion is reduced to form the diol. We can show this reduced to form the purple permanganate ion (MnO4-) then the purple permanganate ion (MnO4-) the
CH2=CH2 (g) + 2H2O(l) → HOCH2CH2OH(ag) + 2H+(ag) + 2e The above two half-equations are clearly not balanced to reduce the permanganate ion and only 2 electrons are released by the oxidation of ethene. So to balance it simply multiply the top equation by x2 and the bottom equation by x5 to give: 2MnO4-
(aq) + 5CH2 = CH2(q) + 6H + (aq) + 2H2O(l) \rightarrow Mn2 + (aq) + 5HOCH2CH2OH(aq) Whereas if ethene gas is bubbled through an alkaline solution for this redox reaction: 2MnO4 - (aq) + 3CH2 = CH2(q) + 4H2O(l) \rightarrow 3HOCH2CH2OH(aq) + MnO2(s) + 2OH-(aq) This time: The permanganate ion
(MnO4-) is reduced to form the green manganate ion MnO42- MnO4-(aq) + e \rightarrow MnO42-(aq) + e \rightarrow MnO42
an alkene, this is called syn addition, we can show this as: However the complete equation for the oxidation reaction as: Key Points There is a common theme in all these reactions of alkenes: Attack by an electrophile on the pi
electrons in the C=C bond The addition of the electrophile to one of the carbon atoms in the C=C results in the production of a carbocation or carbonium ion is then
attacked by a nucleophile which donates two electrons and forms a covalent bond to the carbocation. Potassium permanganate can be used to oxidise alkenes to form diols. Practice questions Alkenes are unsaturated hydrocarbons with at least one carbon-carbon double bond. Due to the presence of this double bond, alkenes exhibit unique reactivity
and undergo a variety of reactions. In this lesson, we will discuss the three major types of reactions are those in which a molecule is added across the carbon-carbon double bond of an alkene, resulting in the formation of a single product. The most common
addition reactions of alkenes involve the addition of hydrogen, halogens, or hydrogen halides. For example, when hydrogen gas is added to ethene (C2H4), the product is ethane (C2H4), as shown below: Substitution reactions: In substitution reactions and the product is ethane (C2H4), as shown below: Substitution reactions and the product is ethane (C2H4), as shown below: Substitution reactions and the product is ethane (C2H4), as shown below: Substitution reactions and the product is ethane (C2H4), as shown below: Substitution reactions and the product is ethane (C2H4), as shown below: Substitution reactions and the product is ethane (C2H4), as shown below: Substitution reactions and the product is ethane (C2H4), as shown below: Substitution reactions and the product is ethane (C2H4), as shown below: Substitution reactions are product is ethane (C2H4), as shown below: Substitution reactions are product is ethane (C2H4), as shown below: Substitution reactions are product is ethane (C2H4), as shown below: Substitution reactions are product is ethane (C2H4), as shown below: Substitution reactions are product is ethane (C2H4), as shown below: Substitution reactions are product is ethane (C2H4), as shown below: Substitution reactions are product is ethane (C2H4), as shown below: Substitution reactions are product is ethane (C2H4), as shown below: Substitution reactions are product is ethane (C2H4), as shown below: Substitution reactions are product is ethane (C2H4), as shown below: Substitution reactions are product is ethane (C2H4), as shown below: Substitution reactions are product is ethane (C2H4), as shown below: Substitution reactions are product is ethane (C2H4), as shown below: Substitution reactions are product is ethane (C2H4), as shown below: Substitution reactions are product is ethane (C2H4), as shown below: Substitution reactions are product is ethane (C2H4), as shown below: Substitution reactions are product is ethane (C2H4), as shown below to the product is ethane (C2H4), as shown below to the product i
the halogenation reaction, in which a halogen atom replaces a hydrogen atom. For example, when chlorine gas is reacted with ethene (C2H4Cl2), as shown below: Elimination reactions: In elimination reactions, a molecule is eliminated from the alkene, resulting in the formation of a double bond. One example
of this is the dehydrohalogenation reaction, in which a hydrogen halide molecule is removed from the alkene. For example, when 2-bromo-3-methylbutane (C5H11Br) is reacted with sodium hydroxide (NaOH), the product is 2-methylbutane (C5H11Br) is reacted with sodium hydroxide (NaOH), the product is 2-methylbutane (C5H11Br) is reacted with sodium hydroxide (NaOH), the product is 2-methylbutane (C5H11Br) is reacted with sodium hydroxide (NaOH), the product is 2-methylbutane (C5H11Br) is reacted with sodium hydroxide (NaOH), the product is 2-methylbutane (C5H11Br) is reacted with sodium hydroxide (NaOH), the product is 2-methylbutane (C5H11Br) is reacted with sodium hydroxide (NaOH), the product is 2-methylbutane (C5H11Br) is reacted with sodium hydroxide (NaOH), the product is 2-methylbutane (C5H11Br) is reacted with sodium hydroxide (NaOH), the product is 2-methylbutane (C5H11Br) is reacted with sodium hydroxide (NaOH), the product is 2-methylbutane (C5H11Br) is reacted with sodium hydroxide (NaOH), the product is 2-methylbutane (C5H11Br) is reacted with sodium hydroxide (NaOH), the product is 2-methylbutane (C5H11Br) is reacted with sodium hydroxide (NaOH), the product is 2-methylbutane (C5H11Br) is reacted with sodium hydroxide (NaOH), the product is 2-methylbutane (C5H11Br) is reacted with sodium hydroxide (NaOH), the product is 2-methylbutane (C5H11Br) is reacted with sodium hydroxide (NaOH), the product is 2-methylbutane (C5H11Br) is
Reaction Library! Visit our Reaction Solver to draw any molecule, select your reagent, and get an answer! Summary Alkenes are unsaturated hydrocarbons that exhibit unique reactivity due to the presence of a carbon-carbon double bond. Addition reactions involve the
substitution of a functional group or atom for a hydrogen atom, and elimination reactions involves the removal of a molecule from an anolecule from the alkene, resulting in the formation of a double bond. Test Your Knowledge: What is the product of the reaction between hydrogen chloride and ethene? What type of reaction involves the removal of a molecule from an anolecule from the alkene, resulting in the formation for a hydrogen chloride and ethene? What type of reaction involves the removal of a molecule from an anolecule from the alkene, resulting in the formation for a hydrogen chloride and ethene? What type of reaction involves the removal of a molecule from an anolecule from the alkene, resulting in the formation for a hydrogen chloride and ethene?
 alkene, resulting in the formation of a double bond? Hydrocarbon compound containing one or more C=C bonds Not to be confused with alkene In organic chemistry, an alkene, or olefin, is a hydrocarbon containing a carbon-carbon double
bond.[1] The double bond may be internal or at the terminal position. Terminal alkenes are also known as α-olefins. The International Union of Pure and Applied Chemistry (IUPAC) recommends using the name "alkene" only for acyclic hydrocarbons with two or
more double bonds; cycloalkene, cycloalkene, cycloalkene, etc. for cyclic ones; and "olefin" for the general class - cyclic or acyclic, with one or more double bonds.[2][3][4] Acyclic alkenes, with only one double bonds and no other functional groups (also known as mono-enes) form a homologous series of hydrocarbons with the general formula CnH2n with n
being a >1 natural number (which is two hydrogens less than the corresponding alkane). When n is four or more, isomers are generally colorless non-polar compounds, somewhat similar to alkanes but more reactive. The first few members of the series are gases
or liquids at room temperature. The simplest alkene, ethylene (C2H4) (or "ethene" in the IUPAC nomenclature) is the organic compound produced on the largest scale industrially.[5] Aromatic compounds are often drawn as cyclic alkenes, however their structure and properties are sufficiently distinct that they are not classified as alkenes or olefins.
[3] Hydrocarbons with two overlapping double bonds (C=C=C) are called allene—and those with three or more overlapping bonds (C=C=C, etc.) are called cumulenes. Alkenes having four or more carbon atoms can form diverse structural isomers. Most alkenes are also isomers of
cycloalkanes. Acyclic alkene structural isomers with only one double bond follow:[6] C2H4: ethylene only C3H6: propylene only C4H8: 3 isomers: 1-butene, 2-methyl-1-butene, 2-methyl-2-butene C5H10: 5 isomers: 1-bexene, 2-hexene, 2-hexene, 2-methyl-1-butene, 2-m
pentene, 3-methyl-1-pentene, 4-methyl-1-butene, 2,3-dimethyl-1-butene, 2,3-dimethyl-1-buten
number of potential isomers increases rapidly with additional carbon atoms. Ethylene (ethene), showing the pi bond in green A carbon-carbon double bond is stronger than a single covalent bond (611 kJ/mol for C=C vs. 347 kJ/mol for C=C),[1] but not twice as strong. Double bonds are shorter
than single bonds with an average bond length of 1.33 Å (133 pm) vs 1.53 Å for a typical C-C single bond. [7] Each carbon atom of the double bond uses its three sp2 hybrid orbitals, which lie perpendicular to the plane created by
the axes of the three sp2 hybrid orbitals, combine to form the pi bond. This bond lies outside the main C-C axis, with half of the bond on one side of the molecule and a half on the carbon-carbon double bond is restricted because it incurs
an energetic cost to break the alignment of the p orbitals on the two carbon atoms. Consequently cis or trans isomers interconvert so slowly that they can be freely handled at ambient conditions without isomerization. More complex alkenes may be named with the E-Z notation for molecules with three or four different substituents (side groups). For
example, of the isomers of butene, the two methyl groups of (Z)-but-2-ene (a.k.a. cis-2-butene) appear on the same side of the double bond, and in (E)-but-2-ene (a.k.a. trans-2-butene) the methyl groups appear on the same side of the double bond, and in (E)-but-2-ene (a.k.a. trans-2-butene) appear on the same side of the double bond, and in (E)-but-2-ene (a.k.a. trans-2-butene) the methyl groups appear on the same side of the double bond, and in (E)-but-2-ene (a.k.a. trans-2-butene) appear on the same side of the double bond, and in (E)-but-2-ene (a.k.a. trans-2-butene) appear on the same side of the double bond, and in (E)-but-2-ene (a.k.a. trans-2-butene) appear on the same side of the double bond, and in (E)-but-2-ene (a.k.a. trans-2-butene) appear on the same side of the double bond, and in (E)-but-2-ene (a.k.a. trans-2-butene) appear on the same side of the double bond, and in (E)-but-2-ene (a.k.a. trans-2-butene) appear on the same side of the double bond, and in (E)-but-2-ene (a.k.a. trans-2-butene) appear on the same side of the double bond, and in (E)-but-2-ene (a.k.a. trans-2-butene) appear on the same side of the double bond, and in (E)-but-2-ene (a.k.a. trans-2-butene) appear on the same side of the double bond, and in (E)-but-2-ene (a.k.a. trans-2-butene) appear on the same side of the double bond, and the appear on the same side of the double bond, and the appear on the same side of the double bond, and the appear on the same side of the appear on 
molecular geometry of alkenes includes bond angles about each carbon atom in a double bond of about 120°. The angle may vary because of steric strain introduced by nonbonded interactions between functional groups attached to the carbon atoms of the double bond. For example, the C-C-C bond angle in propylene is 123.9°. For bridged alkenes,
Bredt's rule states that a double bond cannot occur at the bridgehead of a bridged ring system unless the rings, [9] bicyclic systems require S ≥ 7 for stability[8] and tricyclic systems require S ≥ 11.[10] Main articles: Cis-trans isomerism
and E-Z notation In organic chemistry, the prefixes cis- and trans- are used to describe the positions of functional groups attached to carbon atoms joined by a double bond. In Latin, cis and trans- are used to describe the positions of functional groups attached to carbon chain, the bond is
said to have cis- configuration, otherwise (i.e. the functional groups are on the opposite side of the carbon chain), the bond is said to have trans- configuration. structure of cis-2-butene (E)-But-2-ene (Z)-But-2-ene (Z)-But
attached to each carbon is the same for both. E- and Z- configuration can be used instead in a more general case where all four functional groups attached to carbon atoms in a double bond are different. E- and Z- are abbreviations of German words zusammen (together) and entgegen (opposite). In E- and Z- isomerism, each functional group is
assigned a priority based on the Cahn-Ingold-Prelog priority rules. If the two groups with higher priority are on the opposite side of the double bond, the bond is assigned E- configuration. Cis- and trans- configurations do
not have a fixed relationship between E- and Z-configurations. Many of the physical properties of alkenes are similar: they are colorless, nonpolar, and combustible. The physical properties of alkenes are similar: they are colorless, nonpolar, and combustible. The physical properties of alkenes are similar: they are colorless, nonpolar, and combustible.
temperature. Linear alkenes of approximately five to sixteen carbon atoms are liquids, and higher alkenes are waxy solids. The melting point of the solids also increases with increase in molecular mass. Alkenes generally have stronger smells than their corresponding alkenes, in particular, like
norbornene and trans-cyclooctene are known to have strong, unpleasant odors, a fact consistent with the stronger π complexes they form with metal ions including copper.[11] Below is a list of the boiling and boiling points in °C Number
ofcarbons Alkane Alkene Alkyne 2 Name ethane ethylene acetylene Melting point -183 -169 -80.7 Boiling point -183 -169 -80.7 Boiling point -183 -102.7 Boiling point -185 -102.
pentene 1-pentyne Melting point -130 -165.2 -90.0 Boiling point 36 29.9 40.1 In the IR spectrum, the stretching/compression of C=C bond gives a peak at 1670-1600 cm-1. The band is weak in symmetrical alkenes. The bending of C=C bond gives a peak at 1670-1600 cm-1. The band is weak in symmetrical alkenes.
carbon adjacent to double bonds will give a \deltaH of 4.5-6.5 ppm. The double bond will also deshield the hydrogen attached to the carbons adjacent to sp2 carbons, and this generates \deltaH=1.6-2. ppm peaks.[14] Cis/trans isomers are distinguishable due to different J-coupling effect. Cis vicinal hydrogens will have coupling constants in the range of 6-
14 Hz, whereas the trans will have coupling constants of 11-18 Hz.[15] In their 13C NMR spectra of alkenes, double bonds usually have chemical shift of about 100-170 ppm.[15] Like most other hydrocarbons, alkenes combust to give carbon dioxide and water. The
combustion of alkenes release less energy than burning same molarity of saturated ones with same number of carbons. This trend can be clearly seen in the list of standard enthalpy of combustion of hydrocarbons. This trend can be clearly seen in the list of standard enthalpy of combustion of hydrocarbons. This trend can be clearly seen in the list of standard enthalpy of combustion of hydrocarbons.
 CH2CH3 -2596.6 Alkenes are relatively stable compounds, but are more reactive than alkanes. Most reactions of alkenes involve additions to this pi bond, forming new single bonds. Alkenes serve as a feedstock for the petrochemical industry because they can participate in a wide variety of reactions, prominently polymerization and alkylation.
Except for ethylene, alkenes have two sites of reactivity: the carbon-carbon pi-bond and the presence of allylic Sites are important too. typical electrophilic addition reaction of ethylene to form
ethane is: H2C=CH2 + H2→H3C-CH3 Hydrogenation reactions usually require catalysts to increase their reaction rate. The total number of hydrogenation involves the addition of a halogen molecule, such as Br2, resulting in a dihaloalkane.
The equation of bromination of ethylene to form ethane is: H2C=CH2 + Br2→H2CBr−CH2Br Unlike hydrogenation reactions do not require catalysts. The reaction occurs in two steps, with a halonium ion as an intermediate. Structure of a bromonium ion Bromine test is used to test the saturation of hydrocarbons. [17] The bromine
test can also be used as an indication of the degree of unsaturation for unsaturated hydrocarbons. Bromine as hydrogenation, the halogenation of bromine is also depend on the number of π bond. A higher bromine number indicates higher degree of unsaturation.
The π bonds of alkenes hydrocarbons are also susceptible to hydration. The reaction usually involves strong acid as catalyst.[19] The first step in hydration of ethylene is: H2C=CH2 + H2O→H3C-CH2OH Example of
 hydrohalogenation: addition of HBr to an alkene Hydrohalogenation involves addition of the intermediate carbocation is selective and follows Markovnikov's rule. The hydrohalogenation of alkene will result in haloalkane. The reaction equation of
HBr addition to ethylene is: H2C=CH2 + HBr → H3C-CH2Br Main article: Cycloaddition a Diels-Alder reaction Alkenes add to dienes to give cyclohexenes. This conversion is an example of a Diels-Alder reaction Proceed with retention of stereochemistry. The rates are sensitive to electron-withdrawing or electron-donating substituents.
When irradiated by UV-light, alkenes dimerize to give cyclobutanes. [20] Another example is the Schenck ene reaction, in which singlet oxygen reacts with an allylic structure to give a transposed allyl peroxide: Alkenes react with percarboxylic acids and even hydrogen peroxide to yield epoxides: RCH=CH2 + RCO3H → RCHOCH2 + RCO2H For
ethylene, the epoxidation is conducted on a very large scale industrially using oxygen in the presence of silver-based catalysts: C2H4 + 1/2 O2 \rightarrow C2H4O Alkenes react with ozone, leading to the scission of the double bond. The process is called ozonolysis. Often the reaction procedure includes a mild reductant, such as dimethylsulfide (SMe2):
RCH=CHR'+O3+SMe2 \rightarrow RCHO+R'CHO+O=SMe2 When treated with a hot concentrated, acidified solution of KMnO4, alkenes are cleaved to form ketones and/or carboxylic acids. The stoichiometry of the reaction is sensitive to conditions. This reaction and the ozonolysis can be used to
determine the position of a double bond in an unknown alkene. The oxidation can be stopped at the vicinal diol rather than full cleavage of the alkene by using osmium tetroxide or other oxidation can be stopped at the vicinal diol rather than full cleavage of the alkene by using osmium tetroxide or other oxidation can be stopped at the vicinal diol rather than full cleavage of the alkene by using osmium tetroxide or other oxidation can be stopped at the vicinal diol rather than full cleavage of the alkene by using osmium tetroxide or other oxidation can be stopped at the vicinal diol rather than full cleavage of the alkene by using osmium tetroxide or other oxidation can be stopped at the vicinal diol rather than full cleavage of the alkene by using osmium tetroxide or other oxidation can be stopped at the vicinal diol rather than full cleavage of the alkene by using osmium tetroxide or other oxidation can be stopped at the vicinal diol rather than full cleavage of the alkene by using osmium tetroxide or other oxidation can be stopped at the vicinal diol rather than full cleavage of the alkene by using osmium tetroxide or other oxidation can be stopped at the vicinal diol rather than full cleavage of the alkene by using osmium tetroxide or other oxidation can be stopped at the vicinal diol rather than full cleavage of the alkene by using osmium tetroxide or other oxidation can be stopped at the vicinal diol rather than full cleavage of the alkene by using osmium tetroxide or other oxidation can be stopped at the vicinal diol rather than full cleavage of the alkene by using osmium tetroxide or other oxidation can be stopped at the vicinal diol rather than full cleavage of the alkene by using oxidation can be stopped at the vicinal diol rather than full cleavage of the alkene by using oxidation can be stopped at the vicinal diol rather than the vicinal diol rather than full cleavage of the alkene by using oxidation can be stopped at the vicinal diol rather than the vicinal diol rather than the vicinal diol rathe
is called dihydroxylation. In the presence of an appropriate photosensitiser, such as methylene blue and light, alkenes can undergo reaction with reactive oxygen or superoxide ion. Reactions of the excited sensitizer can involve electron or hydrogen transfer, usually
with a reducing substrate (Type I reaction) or interaction with oxygen (Type II reaction) or interaction conditions, leading to a wide range of products. A common example is the [4+2]-cycloaddition of singlet oxygen with a diene such as cyclopentadiene to yield an
endoperoxide: Main article: polyolefin Terminal alkenes are precursors to polymers via processes termed polymerization. Some polymerization are of great economic significance, as they generate the plastics polyethylene and polymerization are of great economic significance, as they generate the plastics polyethylene and polymerization.
can proceed via diverse mechanisms. Conjugated dienes such as buta-1,3-diene and isoprene (2-methylbuta-1,3-diene) also produce polymers, one example being natural rubber. The presence of a C=C π bond in unsaturated hydrocarbons weakens the dissociation energy of the allylic C-H bonds. Thus, these groupings are susceptible to free radical
substitution at these C-H sites as well as addition reactions at the C=C site. In the presence of radical initiators, allylic C-H bonds can be halogenated. [22] The presence of two C=C bonds flanking one methylene, i.e., doubly allylic, results in particularly weak HC-H bonds. The high reactivity of these situations is the basis for certain free radical
reactions, manifested in the chemistry of drying oils. Alkenes undergo olefin metathesis, which cleaves and interchanges the substituents of the alkene. A related reaction is ethenolysis:[23] ( CH 3 ) 2 C = CH 2 (CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = CH 2 ( CH 3 ) 2 C = 
 {\text{CH3}}} + {\text{CCH3}}}  The Dewar-Chatt-Duncanson model for alkene-metal bonding. Structure of bis(cyclooctadiene)nickel(0), a feed {\ce {CH2}}}} The Dewar-Chatt-Duncanson model for alkene-metal bonding. Structure of bis(cyclooctadiene)nickel(0), a feed {\ce {CH2}}}} The Dewar-Chatt-Duncanson model for alkene-metal bonding. Structure of bis(cyclooctadiene)nickel(0), a feed {\ce {CH2}}}} The Dewar-Chatt-Duncanson model for alkene-metal bonding. Structure of bis(cyclooctadiene)nickel(0), a feed {\ce {CH2}}}}
metal-alkene complex In transition metal d orbital to π* anti-bonding orbital of the alkene. This effect lowers the bond order
of the alkene and increases the C-C bond length. One example is the complexes are related to the mechanisms of metal-catalyzed reactions of unsaturated hydrogenetion alkenes hydrometalation / insertion / beta-
 Hydroformylation aldehydes industrial process, addition of CO and H2 Hydrocarboxylation ester industrial process, addition of CO and H2O. Carboalkoxylation ester industrial process, addition of CO and H2O. Carboalkoxylation ester industrial process, addition of CO and H2O. Carboalkoxylation ester industrial process, addition of CO and H2O. Carboalkoxylation ester industrial process, addition of CO and H2O. Carboalkoxylation ester industrial process, addition of CO and H2O. Carboalkoxylation ester industrial process, addition of CO and H2O. Carboalkoxylation ester industrial process, addition of CO and H2O. Carboalkoxylation ester industrial process, addition of CO and H2O. Carboalkoxylation ester industrial process, addition of CO and H2O. Carboalkoxylation ester industrial process, addition of CO and H2O. Carboalkoxylation ester industrial process, addition of CO and H2O. Carboalkoxylation ester industrial process, addition of CO and H2O. Carboalkoxylation ester industrial process, addition of CO and H2O. Carboalkoxylation ester industrial process, addition of CO and H2O. Carboalkoxylation ester industrial process, addition of CO and H2O. Carboalkoxylation ester industrial process, addition of CO and H2O. Carboalkoxylation ester industrial process, addition of CO and H2O. Carboalkoxylation ester industrial process, addition of CO and H2O. Carboalkoxylation ester industrial process, addition of CO and H2O. Carboalkoxylation ester industrial process, addition of CO and H2O. Carboalkoxylation ester industrial process, addition of CO and H2O. Carboalkoxylation ester industrial process, addition of CO and H2O. Carboalkoxylation ester industrial process, addition of CO and H2O. Carboalkoxylation ester industrial process, addition of CO and H2O. Carboalkoxylation ester industrial process, addition of CO and H2O. Carboalkoxylation ester industrial process, addition ester industrial process.
 Sharpless bishydroxylation diols oxidation, reagent: osmium tetroxide, chiral ligand Woodward cis-hydroxylation diols oxidation, reagents: iodine, silver acetate Ozonolysis aldehydes or ketones reagent: ozone Olefin metathesis alkenes two alkenes rearrange to form two new alkenes Diels-Alder reaction cyclohexenes cycloaddition with a diene
 Pauson-Khand reaction cyclopentenones cycloaddition with an alkyne and CO Hydroboration-oxidation alcohols reagents: borane, then a peroxide Oxymercuration-reduction until addition with aldehyde or ketone Paterno-Büchi reaction oxetanes
 photochemical reaction with aldehyde or ketone Epoxidation epoxide electrophilic addition of a peroxide Cyclopropanation by metal catalyst Hydrophosphination phosphines Alkenes are produced by hydrocarbon cracking. Raw
 materials are mostly natural-gas condensate components (principally ethane and propane) in the US and Mideast and naphtha in Europe and Asia. Alkanes are broken apart at high temperatures, often in the presence of a zeolite catalyst, to produce a mixture of primarily aliphatic alkenes and lower molecular weight alkanes. The mixture is feedstock
 and temperature dependent, and separated by fractional distillation. This is mainly used for the manufacture of small alkenes (up to six carbons).[25] Cracking of n-octane to give pentane and propene Related to this is catalytic dehydrogenation, where an alkane loses hydrogen at high temperatures to produce a corresponding alkene.[1] This is the
reverse of the catalytic hydrogenation of alkenes. Dehydrogenation of butane to give butadiene and isomers of butene at high temperatures by entropy. Catalytic synthesis of higher α-alkenes (of the type RCH=CH2) can also be achieved by a
reaction of ethylene with the organometallic compound triethylaluminium in the presence of nickel, cobalt, or platinum. One of the principal methods for alkene synthesis in the laboratory is the elimination reaction of alkyl halides, alcohols, and similar compounds. Most common is the β-elimination via the E2 or E1 mechanism. [26] A commercially
significant example is the production of vinyl chloride. The E2 mechanism provides a more reliable β-elimination method than E1 for most alkene syntheses. Most E2 elimination start with an alkyl halide or alkyl sulfonate ester (such as a tosylate or triflate). When an alkyl halide is used, the reaction is called a dehydrohalogenation. For unsymmetrical
products, the more substituted alkenes (those with fewer hydrogens attached to the C=C) tend to predominate (see Zaitsev's rule). Two common methods of elimination reactions are dehydrohalogenation of alkyl halides and dehydration of alkyl halides and dehydration of alkyl halides and the C=C) tend to predominate (see Zaitsev's rule). Two common methods of elimination reactions are dehydrohalogenation of alkyl halides and dehydration of alkyl halides and dehy
 this leads to the less stable Z-isomer. [27] An example of an E2 Elimination Alkenes can be synthesized from alcohols via dehydration, in which case water is lost via the E1 mechanism. For example, the dehydration of ethanol produces ethylene: CH3CH2OH \rightarrow H2C=CH2 + H2O An alcohol may also be converted to a better leaving group (e.g.,
xanthate), so as to allow a milder syn-elimination such as the Chugaev elimination and the Grieco elimination such as the Chugaev elimination such as the Chu
to alkenes. Alkenes can be prepared indirectly from alkyl amines. The amine or ammonia is not a suitable leaving group, so the amine oxide (the Cope reaction) to render a smooth elimination possible. The Cope reaction is a syn-elimination that occurs at or below 150 °C,
for example: [28] Synthesis of cyclooctene via Cope elimination The Hofmann elimination is unusual in that the less substituted (non-Zaitsev) alkene is usually the major product. Alkenes are generated from α-halosulfones in the Ramberg-Bäcklund reaction, via a three-membered ring sulfone intermediate. Another important class of methods for alkene
synthesis involves construction of a new carbon-carbon double bond by coupling or condensation of a carbonyl compound (such as an aldehyde or ketone) to a carbanion or its equivalent. Pre-eminent is the aldol condensation. Knoevenagel condensation or its equivalent.
called olefinations. The Wittig reaction is illustrative, but other related methods are known, including the Horner-Wadsworth-Emmons reaction is illustrative, but other related methods are known, including the Horner-Wadsworth-Emmons reaction involves reaction is illustrative, but other related methods are known, including the Horner-Wadsworth-Emmons reaction involves reaction.
 from triphenylphosphine and an alkyl halide. [29] A typical example of the Wittig reaction Related to the Wittig reaction allows for the selection of E- or Z-products. If an E-product is desired, another alternative is the Julia olefination, which uses
the carbanion generated from a phenyl sulfone. The Takai olefination based on an organochromium intermediate also delivers E-products. A titanium compounds; in this case, even esters and amides react. A pair of ketones or aldehydes can be deoxygenated to generate an alkene
Symmetrical alkenes can be prepared from a single aldehyde or ketone coupling with itself, using titanium metal reduction (the McMurry reaction). If different ketones are to be converted to the corresponding alkene via its
 tosylhydrazone, using sodium methoxide (the Bamford-Stevens reaction) or an alkyllithium (the Shapiro reaction). The formation of longer alkenes via the step-wise polymerisation of smaller ones is appealing, as ethylene (the smallest alkene) is both inexpensive and readily available, with hundreds of millions of tonnes produced annually. The Ziegler
Natta process allows for the formation of very long chains, for instance those used for polyethylene. Where shorter chains are wanted, as they for the production of surfactants, then processes incorporating a olefin metathesis step, such as they for the production of surfactants, then processes incorporating a olefin metathesis step, such as they for the production of surfactants, then processes incorporating a olefin metathesis step, such as they for the production of surfactants, then processes incorporating a olefin metathesis step.
interconversion of ethylene and 2-butene to propylene. Rhenium- and molybdenum-containing heterogeneous catalysis are used in this process:[30] CH2=CH2 + CH3CH=CHCH3 Transition metal catalyzed hydrovinylation of a
hydrogen and a vinyl group (or an alkenyl group) across a double bond. Reduction of alkynes is a useful method for the stereoselective synthesis of disubstituted alkenes. If the cis-alkene is desired, hydrogenation in the presence of Lindlar's catalyst (a heterogeneous catalyst that consists of palladium deposited on calcium carbonate and treated with
 various forms of lead) is commonly used, though hydroboration followed by hydrolysis provides an alternative approach. Reduction of the alkynes For the preparation multisubstituted alkenes, carbometalation of alkynes can give rise to a
large variety of alkene derivatives. Alkenes can be synthesized from other alkenes via rearrangement reactions. Besides olefin metathesis (described above), many pericyclic reactions can be used such as the ene reaction and the Cope rearrangement of divinylcyclobutane to cyclooctadiene In the Diels-Alder reaction, a
cyclohexene derivative is prepared from a diene and a reactive or electron-deficient alkene. Unsaturated hydrocarbons are widely used to produce plastics, medicines, and other useful materials. Name Structure Use Ethylene Monomers for synthesizing polyethylene 1,3-butadiene For manufacturing synthetic rubber vinyl chloride Precursor to PVC
styrene precursor to polystyrene Alkenes are prevalent in nature. Plants are the main natural source of alkenes, ethylene is a signaling
 molecule that influences the ripening of plants. The Curiosity rover discovered on Mars long chain alkanes with up to 12 consecutive carbon atoms. They could be derived from either abiotic or biological sources. [34] Selected unsaturated compounds in nature Limonene, a monoterpene. Humulene, a sesquiterpene. Taxadiene, a diterpene, precursor to
the diterpenoid taxol, an anticancer agent. Squalene, a triterpene and universal precursor to natural steroids. Although the nomenclature is not followed widely, according to IUPAC, an alkene is an acyclic alkenes as well as
dienes and polyenes.[3] To form the root of the IUPAC names for straight-chain alkenes, change the -an- infix of the parent to -en-. For example, CH3-CH3 is the alkane ethANe. The name of CH2=CH2 is therefore ethENe. For straight-chain alkenes with 4 or more carbon atoms, that name does not completely identify the compound. For those cases
and for branched acyclic alkenes, the following rules apply: Find the longest carbon chain in the molecule. If that chain does not contain the double bond, name the compound according to the alkane naming rules. Otherwise: Number the carbons in that chain starting from the end that is closest to the double bond. Define the location k of the double
bond as being the number of its first carbon. Name the side groups (other than hydrogen) according to the appropriate rules. Define the position and name of each side group. Write the names of the alkane with the same chain, replacing the "-ane" suffix by "k-
pentane", whereas (H3C)3C-CH=CH2 is "3,3-dimethyl 1-pentene". More complex rules apply for polyenes and cycloalkenes.[4] Naming substituted hex-1-enes If the double bond of an acyclic mono-ene is not the first bond of the chain, the name as constructed above still does not completely identify the compound, because of cis-trans isomerism. Then
one must specify whether the two single C-C bonds adjacent to the double bond are on the same side of") or trans- ("across", "on the other side of") before the name, respectively; as in cis-2-pentene or trans-2-butene.
The difference between cis- and trans- isomers More generally, cis-trans isomerism will exist if each of the two carbons of in the double bond has two different atoms or groups attached to it. Accounting for these cases, the IUPAC recommends the more general E-Z notation, instead of the cis and trans prefixes. This notation considers the group with
 highest CIP priority in each of the two carbons. If these two groups are on opposite sides of the double bond's plane, the configuration is labeled E (from German zusammen, "together"). This labeling may be taught with mnemonic "Z means 'on ze zame zide'
 [35] The difference between E and Z isomers IUPAC recognizes two names for hydrocarbon groups containing carbon-carbon double bonds, the vinyl group Eductionary. Wikiquote has quotations related to Alkene. Alpha-olefin Annulene Aromatic hydrocarbon ("Arene") Dendralene
 Nitroalkene Radialene Rule A-3. Unsaturated Compounds and Univalent Radicals IUPAC Blue Book. Rule A-4. Bivalent and Multivalent Radicals IUPAC Blue Book. Rule A-11.4, A-11.5 Unsaturated monocyclic hydrocarbons IUPAC Blue Book. Rule A-2.
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 Number 203-449-2 Gmelin Reference 25205 PubChem CID 7844 UNII LY001N554L Y UN number 1012 CompTox Dashboard (EPA) DTXSID1026746 InChI = 1/C4H8/c1-3-4-2/h3H,1,4H2,2H3Key: VXNZUUAINFGPBY-UHFFFAOYAZ SMILES C=CCCCC=C
 Properties Chemical formula C4H8 Molar mass 56.108 g·mol-1 Appearance Colorless gas Odor slightly aromatic Density 0.62 g/cm3 Melting point -6.47 °C (20.35 °F; 87.8 K) Boiling point -6.47 °C (20.35 °F; 87.8 K) Boiling point -185.3 °C (-301.5 °F; 87.8 K) Boiling point -6.47 °C (20.35 °F; 87.8 K) Boiling point -185.3 °C (-301.5 °F; 87.8 K) Boiling point -6.47 °C (20.35 °F; 87.8 K) Boiling point -6.47 °C (20
 Hazards GHS labelling: Pictograms Signal word Danger Hazard statements H220 Precautionary statements P210, P377, P381, P403, P410+P403 NFPA 704 (fire diamond) 1 4 0 Flash point -79 °C; -110 °F; 194 K Autoignitiontemperature 385 °C (725 °F; 658 K) Explosive limits 1.6-10% Except where otherwise noted, data are given for materials in
 their standard state (at 25 °C [77 °F], 100 kPa). N verify (what is YN ?) Infobox references Chemical compound 1-Butene (IUPAC name: But-1-ene, also known as 1-butylene) is the organic compound with the formula CH3CH2CH=CH2. It is a colorless gas, but easily condensed to give a colorless liquid. It is classified as a linear alpha-olefin (terminal
alkene).[2] It is one of the isomers of butene (butylene, which is used to make piping for domestic plumbing.[3] Another application is as a comonomer in the products. Polymerization of 1-butene gives polybutylene, which is used to make piping for domestic plumbing.[3] Another application is as a comonomer in the products.
been used as a precursor to polypropylene resins, butylene oxide, and butanone.[5] 1-Butene is produced by separation from crude C4 refinery streams and by ethylene dimerization. The former affords a mixture of 1-and 2-butenes, while the latter affords only the terminal alkene.[6] It is distilled to give a very high purity product. An estimated 12
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