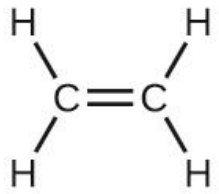
HW 15, chemistry 2
ALKENES

Alkenes - unsaturated hydrocarbons, they have one or more carbon – carbon double bond. The simplest alkene C2H4, ethene,



Hydrocarbon	Formula	Bp, °C	Mp, °C	Density, d_4^{20}
ethane	$CH_3—CH_3$	−88.6	−183[a]	
ethene	$CH_2=CH_2$	−105	−169	
ethyne	$CH\equiv CH$	−83	−81	
propane	$CH_3—CH_2—CH_3$	−42.1	−187[a]	0.501[b]
propene	$CH_3—CH=CH_2$	−47.8	−185[a]	0.514[b]
propyne	$CH_3—C\equiv CH$	−23.2	−102.7	0.706[b]
butane	$CH_3—CH_2—CH_2—CH_3$	−0.5	−138	0.579[b]
1-butene	$CH_3—CH_2—CH=CH_2$	−6.3	−185[a]	0.595[b]
cis-2-butene	$CH_3—CH=CH—CH_3$	3.7	−139	0.621[b]
trans-2-butene	$CH_3—CH=CH—CH_3$	0.9	−106	0.604[b]
1-butyne	$CH_3—CH_2—C\equiv CH$	8.1	−126	0.65[b]
2-butyne	$CH_3—C\equiv C—CH_3$	27.0	−32	0.691
pentane	$CH_3—CH_2—CH_2—CH_2—CH_3$	36.1	−129	0.626
1-pentene	$CH_3—CH_2—CH_2—CH=CH_2$	30.0	−165	0.641
cis-2-pentene	$CH_3—CH_2—CH=CH—CH_3$	37.9	−151	0.656
trans-2-pentene	$CH_3—CH_2—CH=CH—CH_3$	36.4	−140	0.648
1-pentyne	$CH_3—CH_2—CH_2—C\equiv CH$	40.2	−106	0.690
2-pentyne	$CH_3—CH_2—C\equiv C—CH_3$	56.1	−109	0.711
hexane	$CH_3—CH_2—CH_2—CH_2—CH_2—CH_3$	68.7	−95	0.659
1-hexene	$CH_3—CH_2—CH_2—CH_2—CH=CH_2$	63.5	−140	0.674
cis-2-hexene	$CH_3—CH_2—CH_2—CH=CH—CH_3$	68.8	−141	0.687
trans-2-hexene	$CH_3—CH_2—CH_2—CH=CH—CH_3$	67.9	−133	0.678
cis-3-hexene	$CH_3—CH_2—CH=CH—CH_2—CH_3$	66.4	−138	0.680
trans-3-hexene	$CH_3—CH_2—CH=CH—CH_2—CH_3$	67.1	−113	0.677
1-hexyne	$CH_3—CH_2—CH_2—CH_2—C\equiv CH$	71	−132	0.716
2-hexyne	$CH_3—CH_2—CH_2—C\equiv C—CH_3$	84.0	−88	0.732
3-hexyne	$CH_3—CH_2—C\equiv C—CH_2—CH_3$	81.8	−105	0.724

[a]At the triple point (i.e., the temperature at which the solid, liquid, and vapor all are in equilibrium).
[b]Under pressure.

How to name alkenes: number the main chain from the end nearer to the double bond, put this number in the name, also do not forget the positions and names of the substituent groups. CH3 CH3

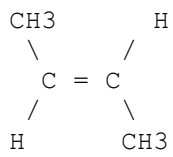
CH3 – C = C -CH3 **2,3 -dimethyl-2-butene**

Remember, Cl- Br- groups will be called chloro-, bromo-.

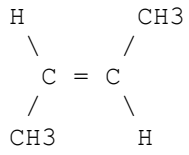
Cis and trans isomers of alkenes are types of **geometric (stereoisomeric) isomers**, meaning they have the same molecular formula and connectivity of atoms but differ in their spatial arrangement around a **double bond (C=C)**.

1. Why Do Cis and Trans Isomers Exist?

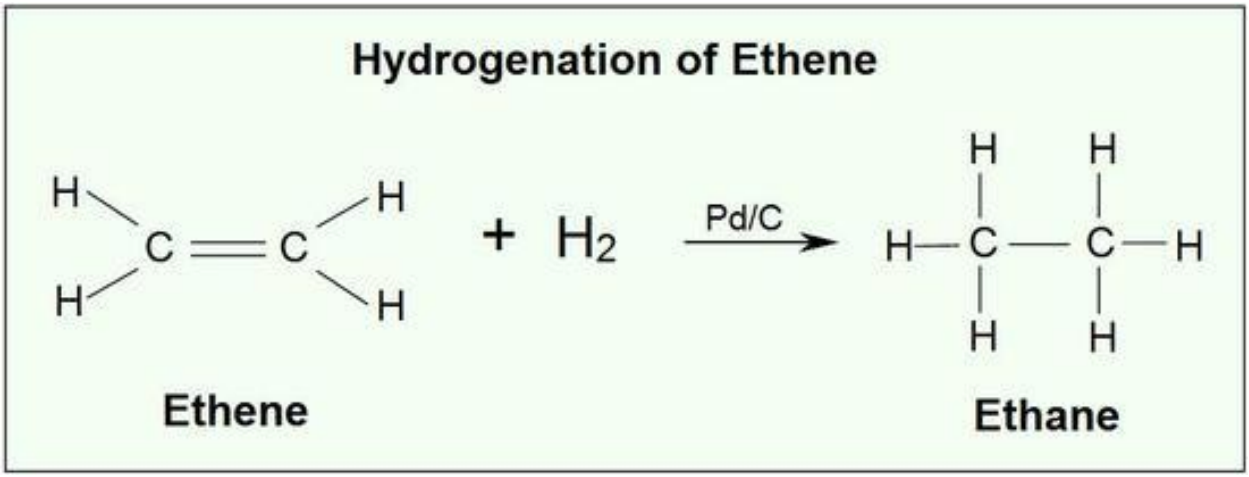
- Alkenes contain a **double bond**, which restricts **free rotation** around the carbon-carbon bond.
- When two different groups are attached to each carbon of the double bond, two possible geometric configurations arise: **cis** and **trans**.
  - **Cis-Isomer (Z-Isomer)**
    - The **two identical or similar groups** are on the **same side** of the double bond.
    - Example: **Cis-2-butene**



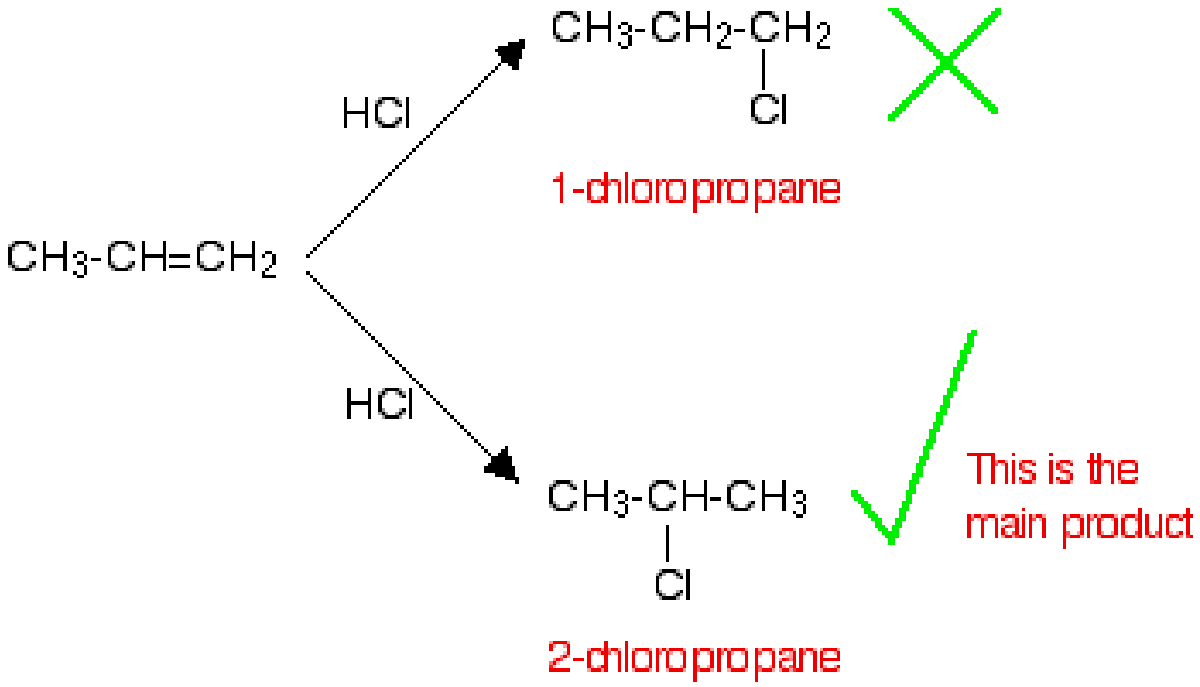
  - **Trans-Isomer (E-Isomer)**
    - The **two identical or similar groups** are on **opposite sides** of the double bond.
    - Example: **Trans-2-butene**



The most characteristic reaction of alkenes is the addition reactions, where double bond is broken and new single bonds are formed.
For example:



When you write addition reactions of alkenes with such compounds like water or hydrogen halides you have to remember Markovnikov's rule:
H attaches to the carbon that already has more H atoms



Questions:

Write the condense structural formulas and the names of the product in the following reactions:

1. CH3 – CH2 – CH=CH2 +Br2 →
2. *Cis*-2 -butene + H2 →

3. CH3

CH3 – C = CH -CH2 – CH3 + Cl2 →

4. CH3-CH=CH-CH3 + HBr →
5. CH2=CH-CH2-CH3 + HCl →