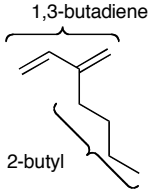
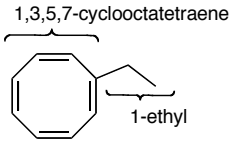
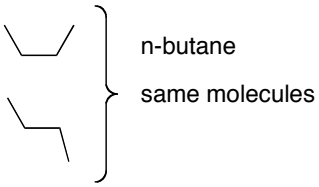
Nomenclature Alkenes and Alkynes - continued

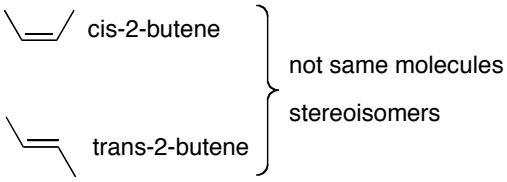


2-butyl-1,3-butadiene



1-ethyl-1,3,5,7-cyclooctatetraene

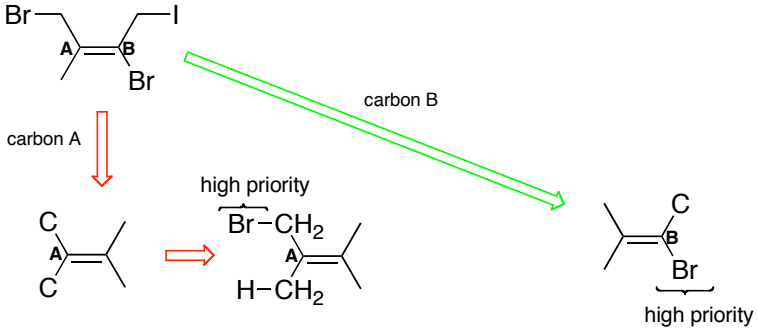




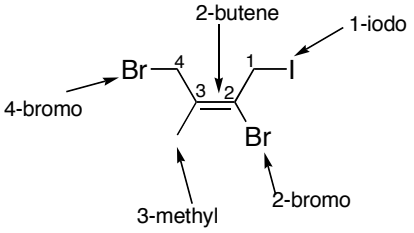
E / *Z* nomenclature

1. look at 1st end of double bond
2. decide which atoms have largest atomic number
3. if cannot decide, go to the next set of atoms (until you can reach a decision)
4. do the same at other end of the double bond
5. *Z* (Zusammen – together) → same side
   E (Entgegen – opposite) → opposite side

Eg.



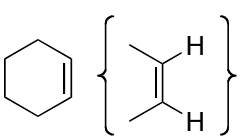
- high priority groups are on opposite sides
- so the molecule has *E* configuration



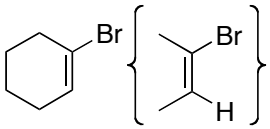
(E)-2,4-dibromo-1-iodo-3-methyl-2-butene

or

(E)-1,3-dibromo-4-iodo-2-methyl-2-butene



cis-cyclohexene or *Z*-cyclohexene normally called just **cyclohexene** as double bond always cis (*Z*)



E-1-bromocyclohexene normally called just **1-bromocyclohexene** as double bond geometry always fixed

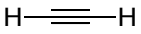
note: in small ring system without any side groups (n < 8) - always *cis* (*Z*) double bond

Nomenclature of alkynes

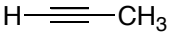
Rule:

- find the longest chain with maximum number of triple bonds, side groups, etc.
- number to give 1st multiple bonded (double bond / triple bond) position the lowest number
- drop "ane" and add "yne"
- for multiple triple bonds, drop "ne" and add "diyne"," triyne", etc.

eg.

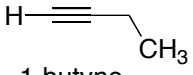


- ethyne / acetylene (common name)
- sp-hybridized carbon atoms, linear structure
- σ bond between C and H
- one σ and two π bonds between the two carbons
- explosive gas



propyne

methylacetylene (common name)

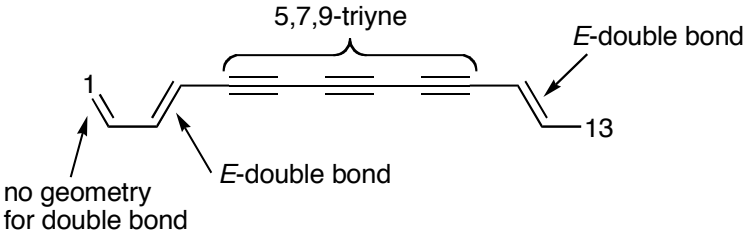


1-butyne

ethylacetylene

2-butyne

dimethylacetylene



Trideca-1,3[*E*],11[*E*]-trien-5,7,9-triyne

In nature :

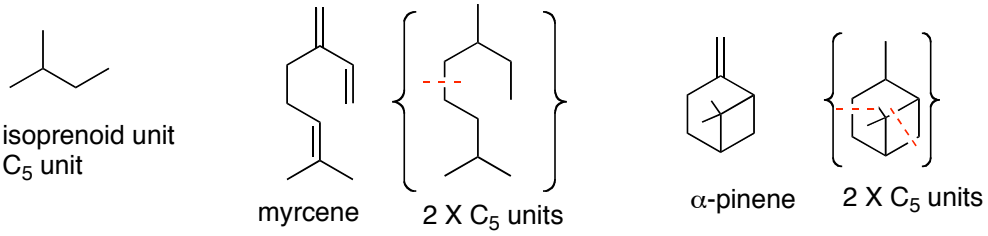
- alkenes → very common
- alkynes → > 1000 alkynes known (often defense substances in plants)

Hydrocarbons → C and H only

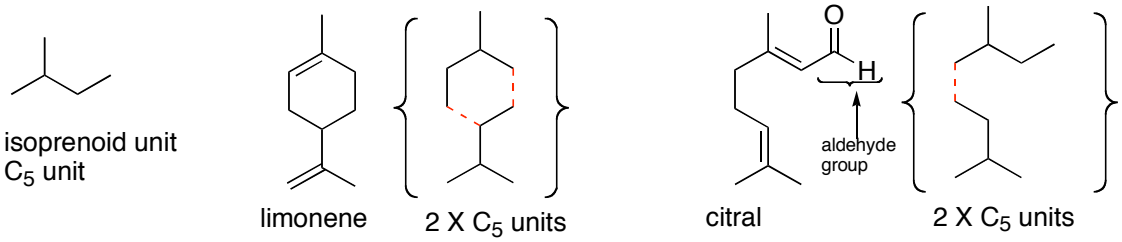
- alkanes – most non-polar
- alkenes – intermediate polarity between alkanes and alkynes
- alkynes – more polar

- overall, they all are very non-polar
- density less than water (1.0 g/cm^3) – float on water
- immiscible with water
- dissolve well in non-polar solvents (like-dissolves-like)
- low mp, bp compared to other organic molecules of similar size with more electronegative atoms
- London (dispersion) forces control self association

Isoprenes or Isoprenoids (also known as – terpenes / terpenoids)

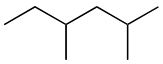


- myrcene – perfume – a monoterpene (C_{10} unit)
- pinene is also a monoterpene (two isoprene units)

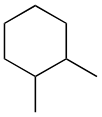


Degrees of Unsaturation:

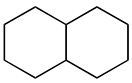
- all non-cyclic alkanes → have the general formula of C_nH_{2n+2}



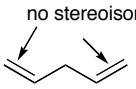
2,4-dimethylhexane
C_8H_{18}
has no (zero) degree of unsaturation



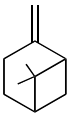
1,2-dimethylcyclohexane
C_8H_{16}
has one degree of unsaturation



$C_{10}H_{18}$
has 2 degrees of unsaturation



1,4-pentadiene
C_5H_8
has 2 degrees of unsaturation

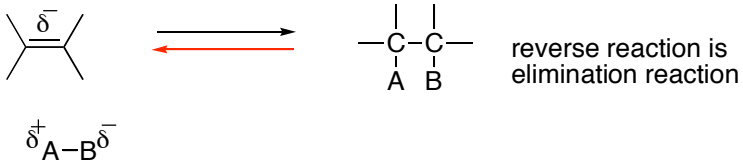


α-pinene
$C_{10}H_{16}$
has 3 degrees of unsaturation

- in a molecule, a double bond or a ring system represents one degree of unsaturation

Reactions of alkene

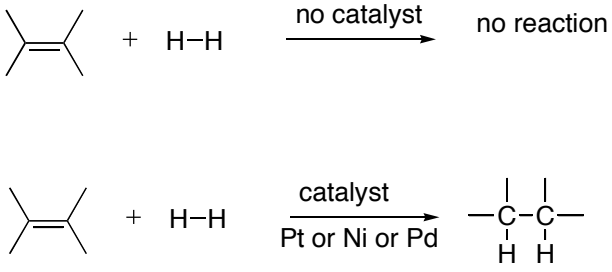
General reaction → addition reaction



reverse reaction is
elimination reaction

A=B=H → hydrogenation reaction – addition of hydrogen to double bond

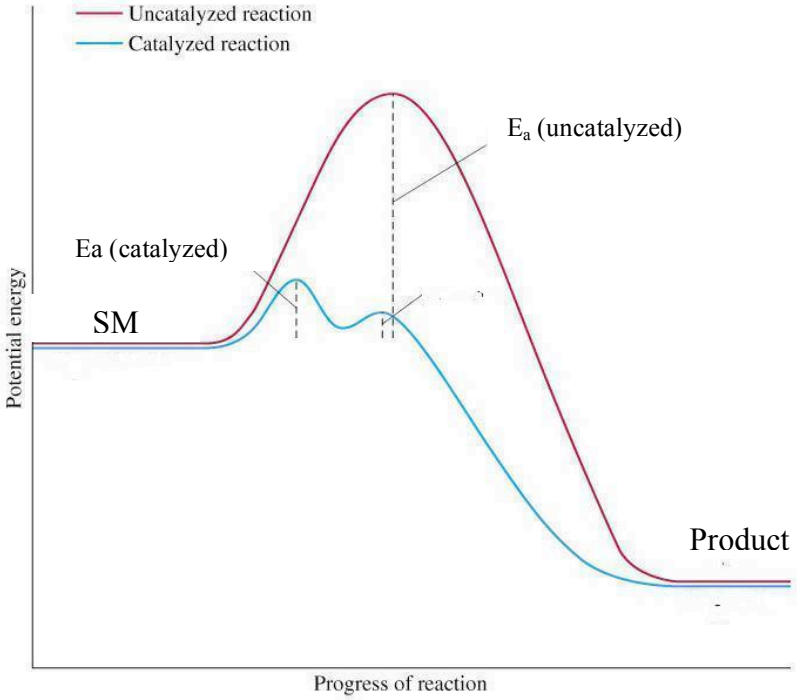
- syn or cis addition of H_2 → addition of hydrogen from same side of the double bond



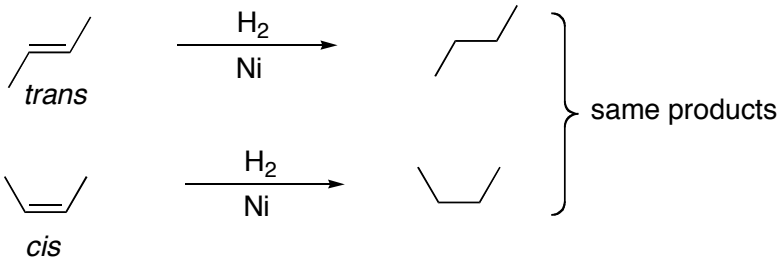
- catalyst helps to break the H-H bond and interacts with alkene electrons, which lowers the activation energy of the reaction

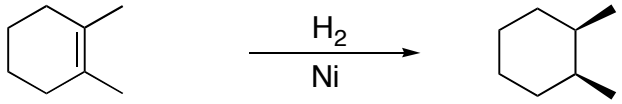
Catalyst:

- lowers activation energy but remains unchanged overall



SM : alkene and H_2
Product : alkane (after hydrogenation)





1,2-dimethylcyclohexene *cis*-1,2-dimethylcyclohexane

- hydrogenation was syn (cis) addition, giving the cis-product as above