ALKENES

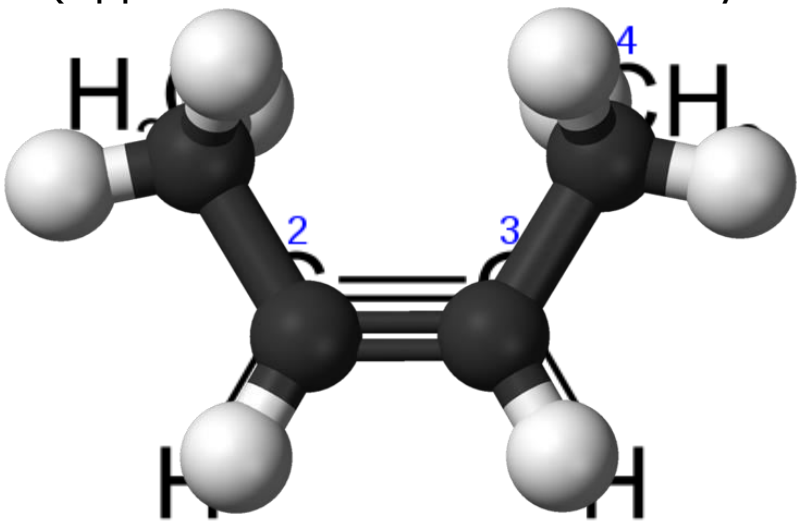
ALKENES

-Characterized by C=C double bond(s)

-Classified as *unsaturated hydrocarbons*

-empirical formula = C_nH_{2n}

(applies when the molecule only has one double bond)

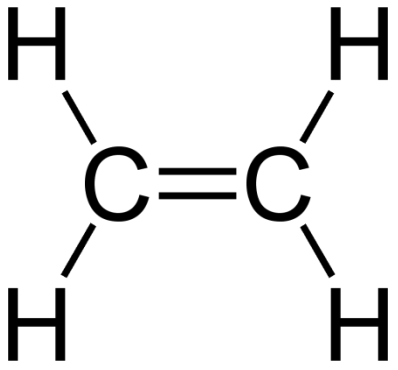


→ C_nH_{2n}, n=4

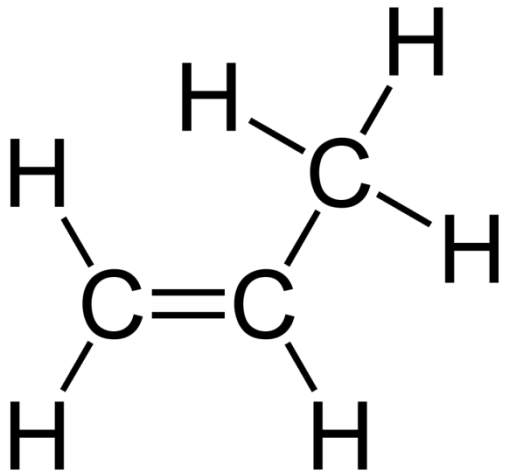
= C_4H_8

ALKENES

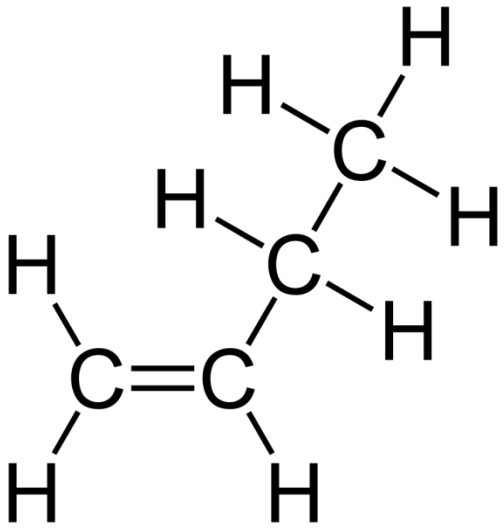
Some IUPAC names of alkenes:



ethene



propene

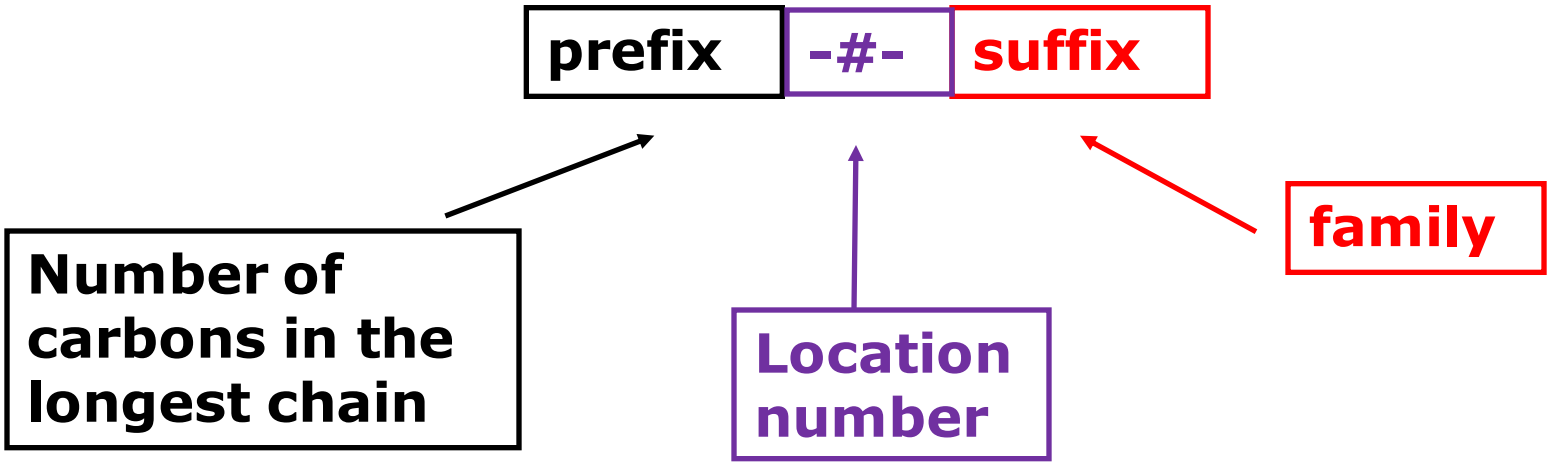


but-1-ene

All alkenes have the suffix "ene"

ALKENES

IUPAC naming system:

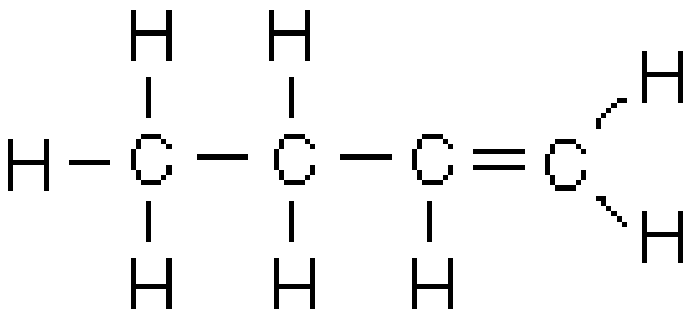


Ex: **but-1-ene**

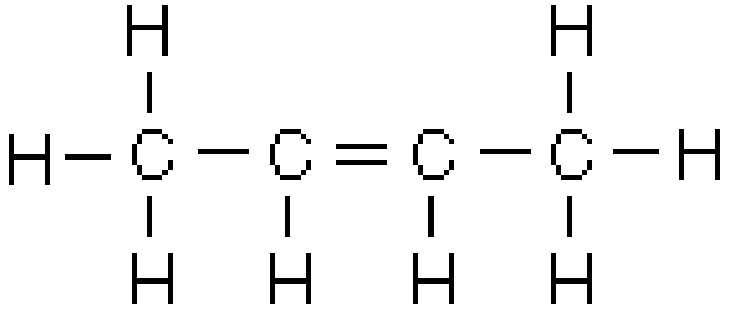
ALKENES

IUPAC naming system:

Name the following alkenes:



but-1-ene

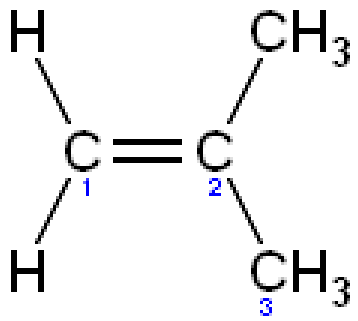


but-2-ene

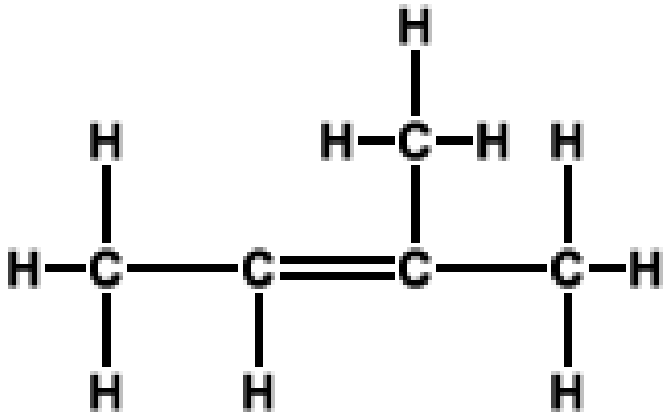
ALKENES

IUPAC naming system:

Name the following alkenes:



methylpropene



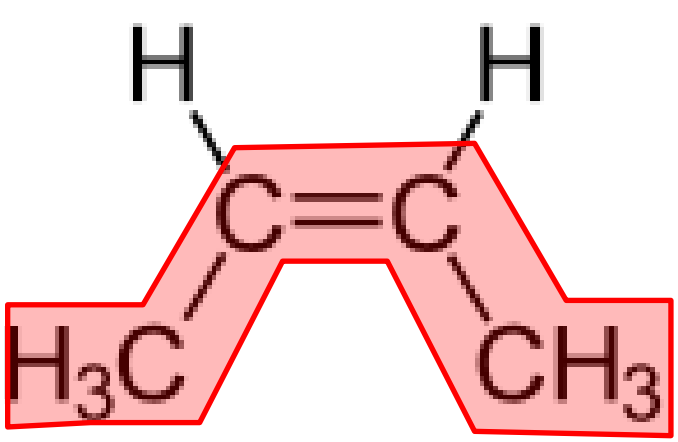
methylbut-2-ene

The double bond has a higher numbering priority than the alkyl and halide substituents

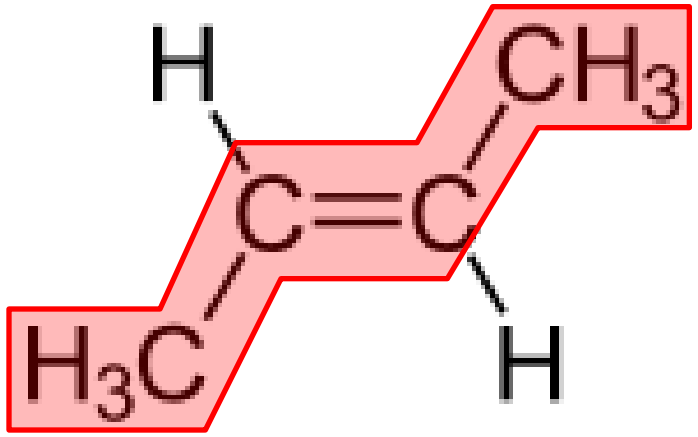
ALKENES

IUPAC naming system:

Name the following alkenes:



cis-but-2-ene



trans-but-2-ene

cis *= longest chain forms a U shape*

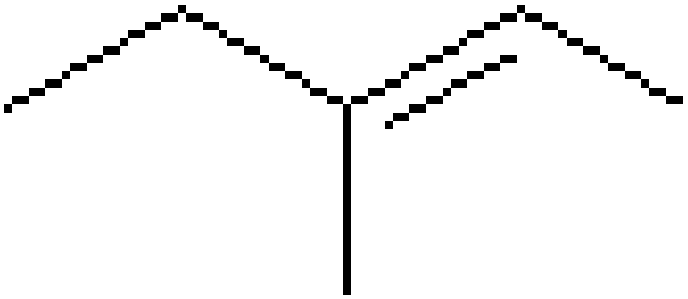
trans *= longest chain forms a Z shape*

Geometric isomers

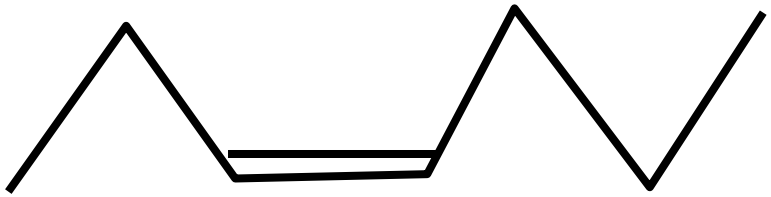
ALKENES

IUPAC naming system:

Name the following alkenes:



trans-3-methylpent-2-ene

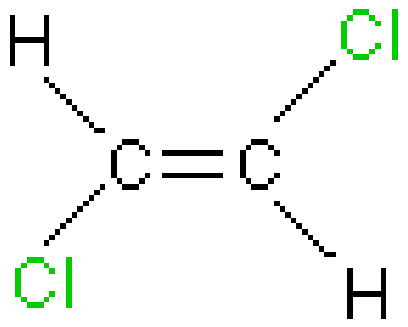


cis-hept-3-ene

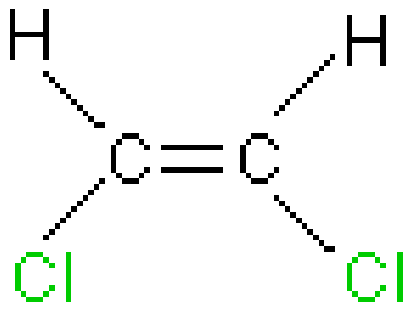
ALKENES

IUPAC naming system:

Name the following alkenes:



trans-1,2-dichloroethene



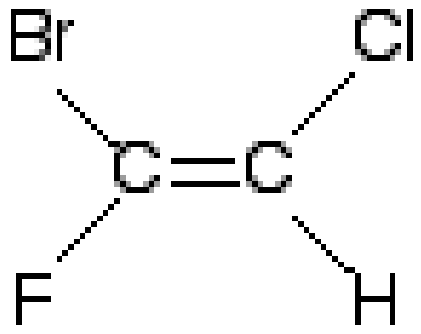
cis-1,2-dichloroethene

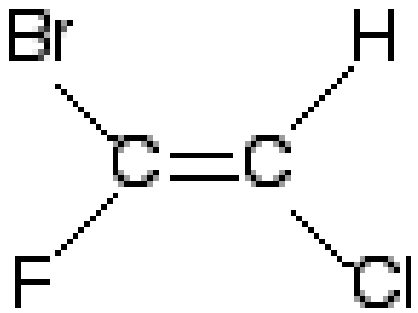
ALKENES

IUPAC naming system:

cis and trans have limitations.

Try naming the following alkenes:





Since both molecules are different, they must be differentiated by name. However, cis and trans cannot be used in this case as each carbon atom has two different groups, unlike in the previous examples.

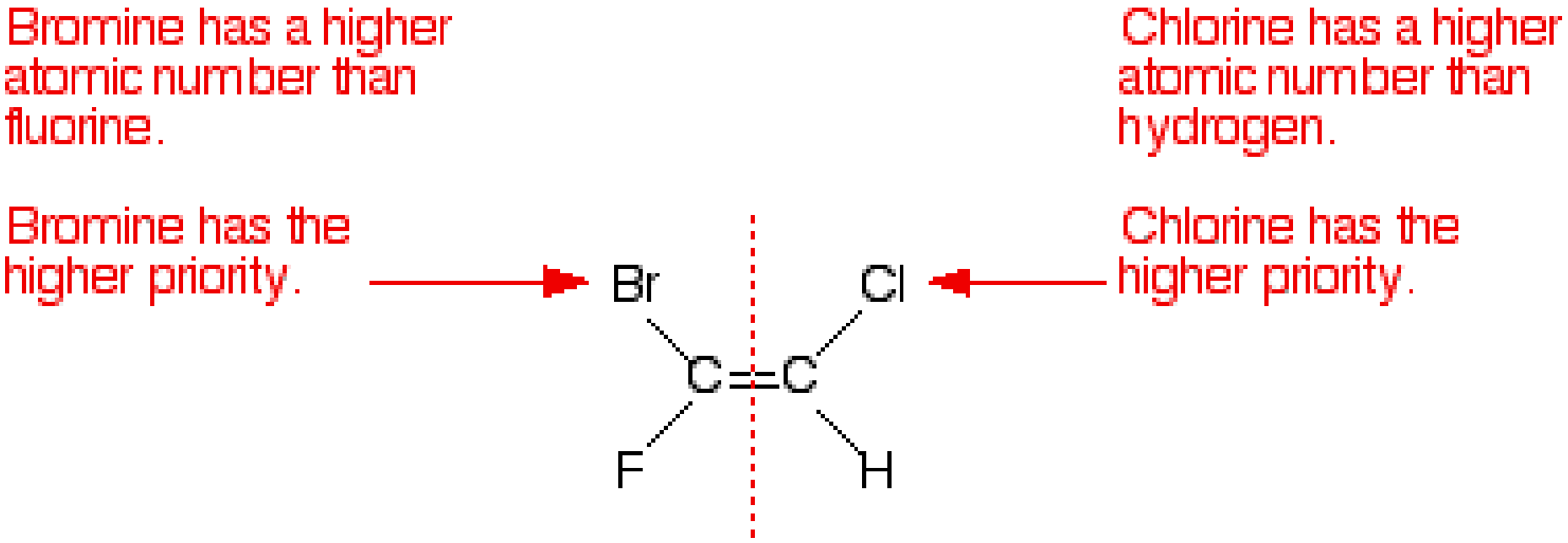
ALKENES

IUPAC naming system:

E-Z notation:

(*E*)- : the higher priority groups are on opposite sides of the double bond.

(*Z*)- : the higher priority groups are on the same side of the double bond.

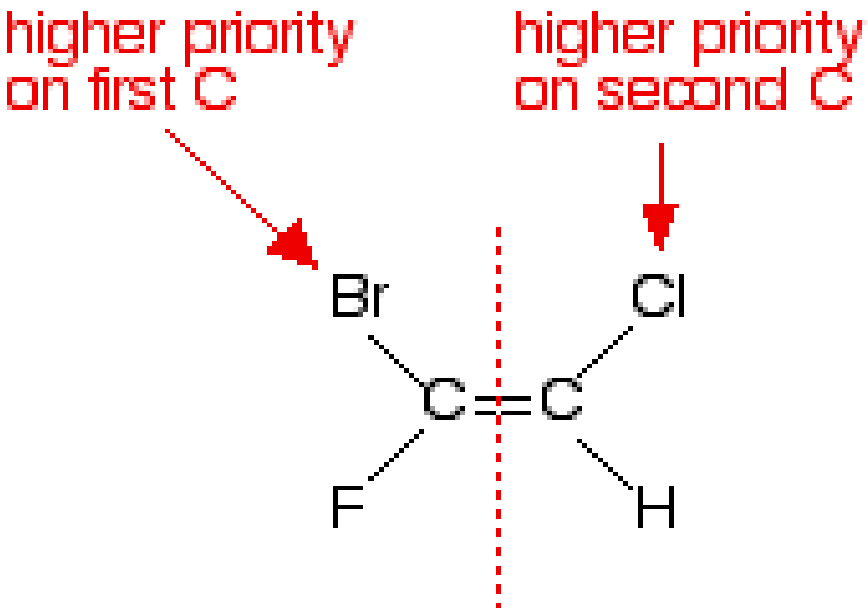


The atom which has the higher atomic number is given the higher priority.
We look only at the atoms directly attached to the double bond.

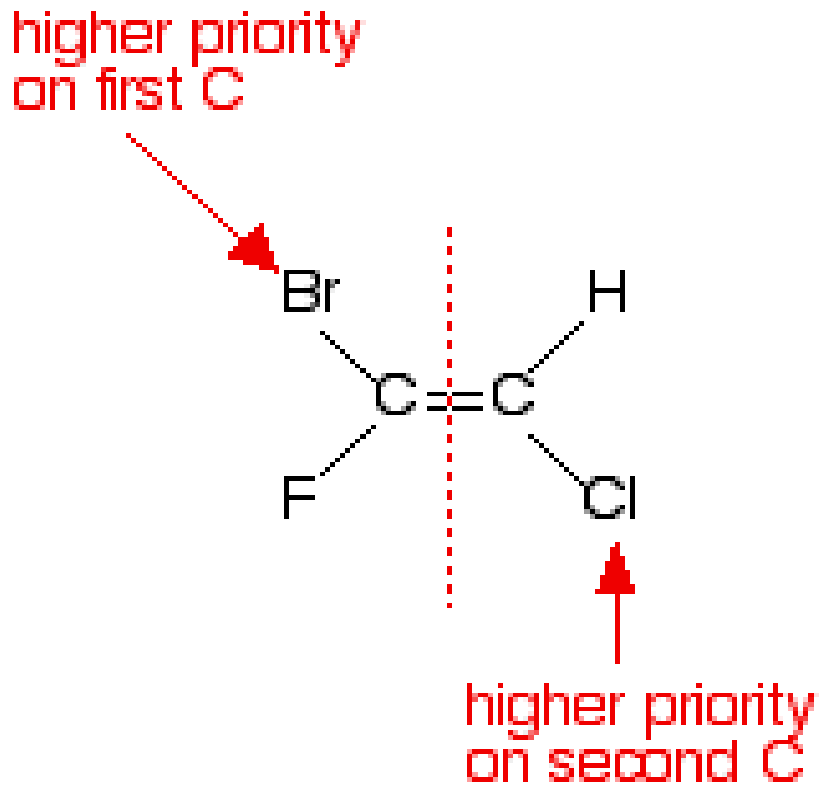
ALKENES

IUPAC naming system:

E-Z notation names:



(*Z*)-1-bromo-2-chloro-1-fluoroethene

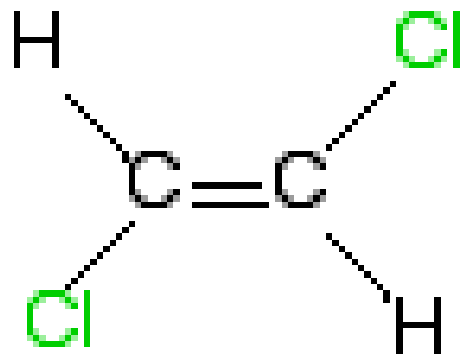


(*E*)-1-bromo-2-chloro-1-fluoroethene

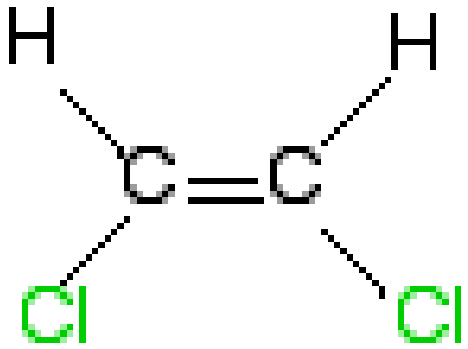
ALKENES

IUPAC naming system:

Name the following alkenes:



(*E*)-1,2-dichloroethene

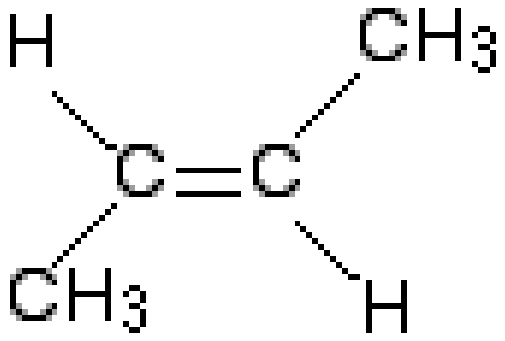


(*Z*)-1,2-dichloroethene

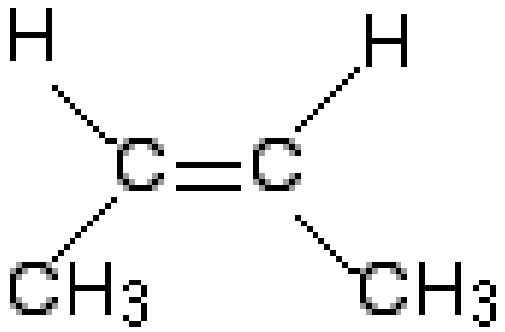
ALKENES

IUPAC naming system:

Name the following alkenes:



(2*E*)-but-2-ene

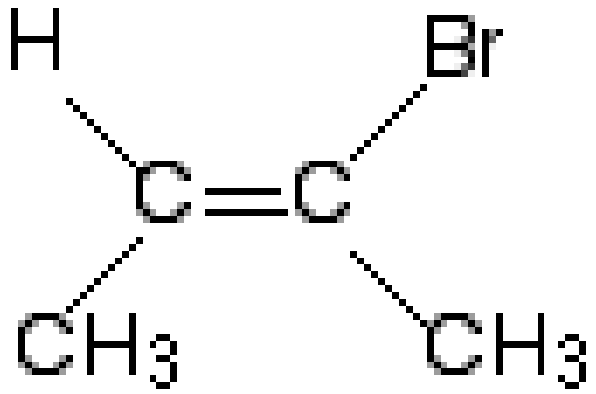


(2*Z*)-but-2-ene

ALKENES

IUPAC naming system:

Name the following alkene:



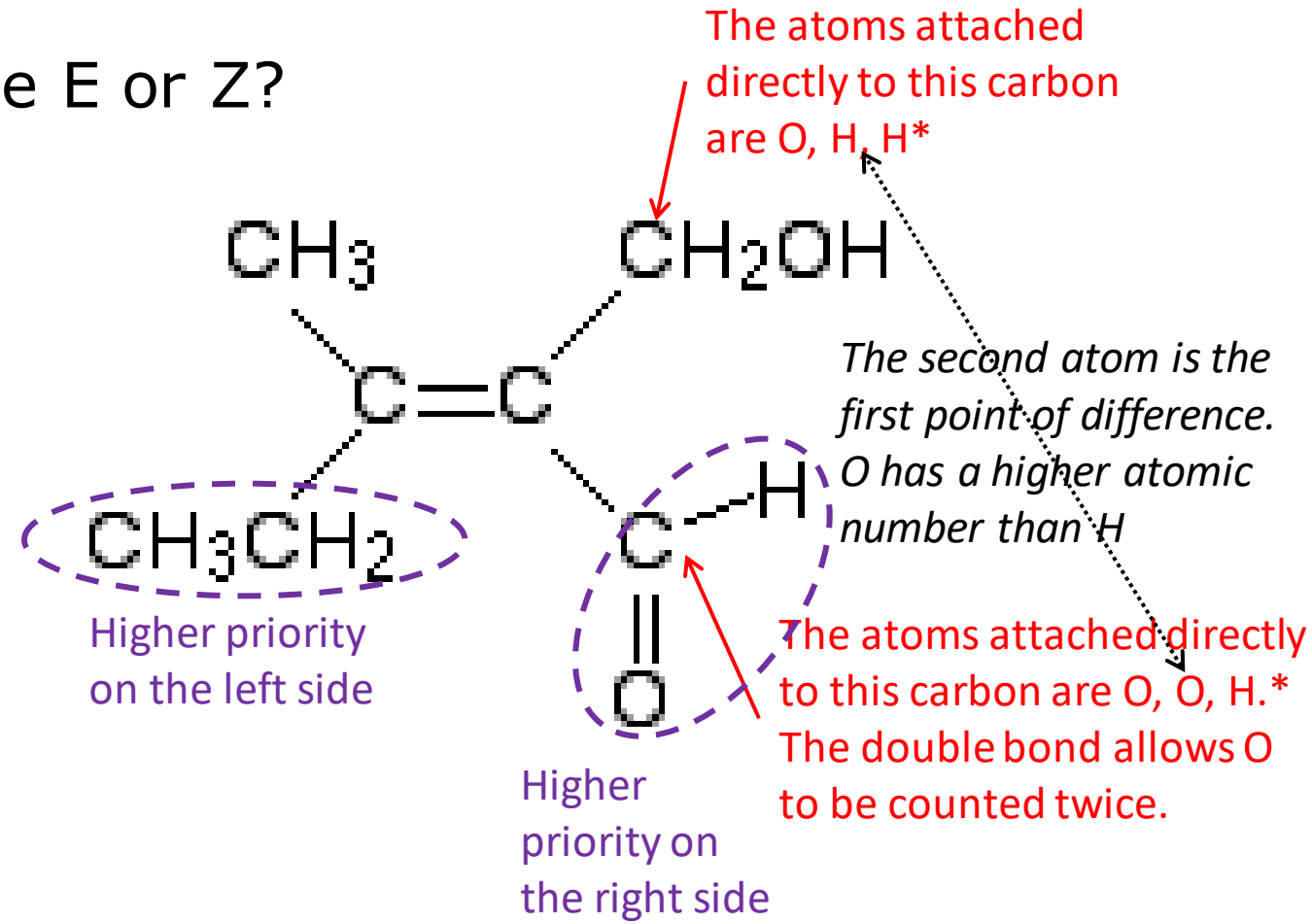
(2*E*)-2-bromobut-2-ene

Although this looks like a cis structure, Br actually has higher priority than CH_3, because the atomic number of Br is higher than C

ALKENES

IUPAC naming system:

Is this molecule E or Z?



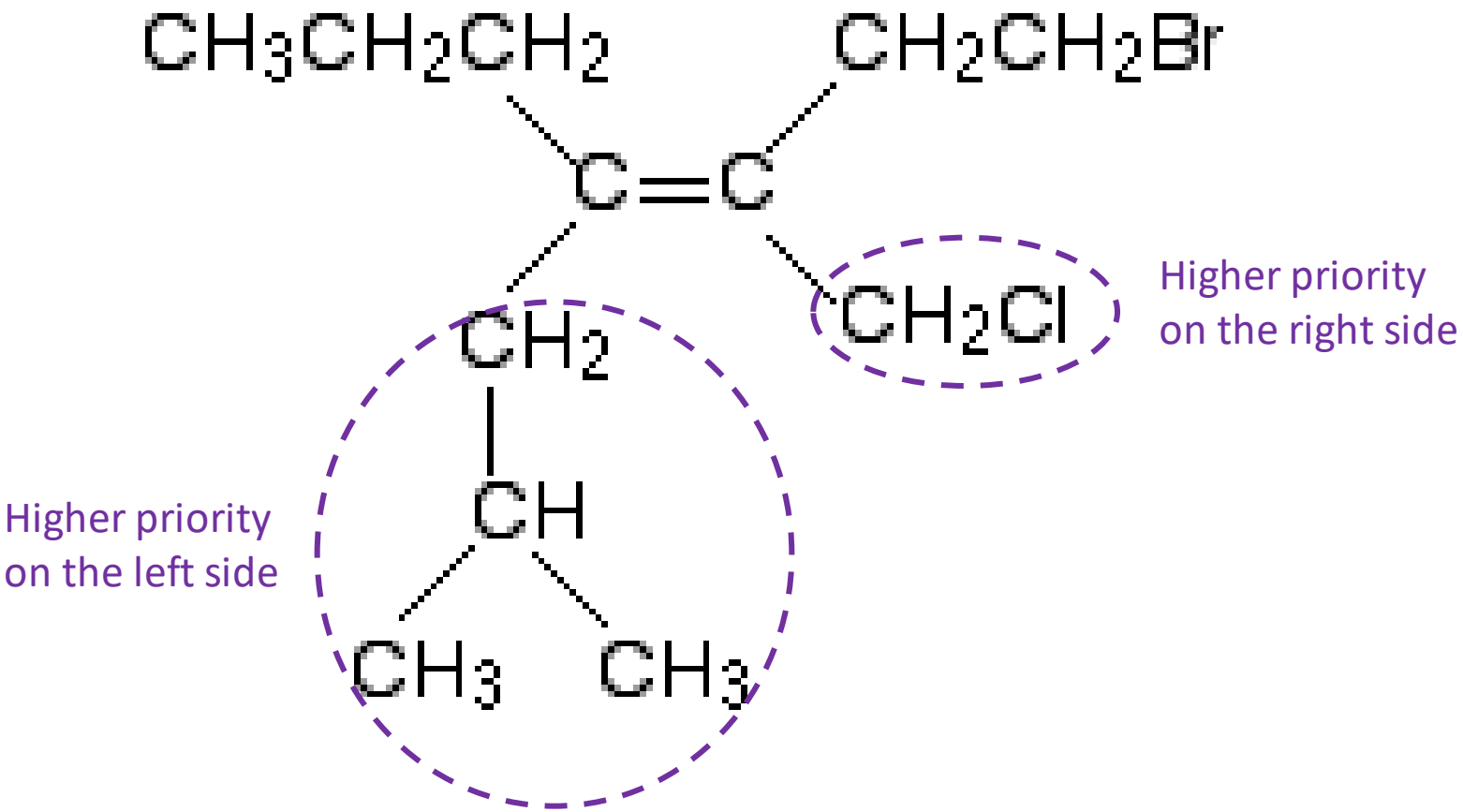
.: the molecule has Z geometry

*higher atomic number atoms are written first

ALKENES

IUPAC naming system:

Is this molecule E or Z?

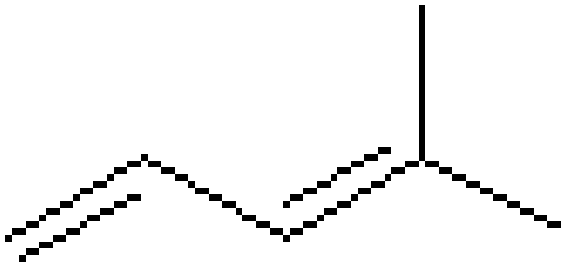


.: the molecule has Z geometry

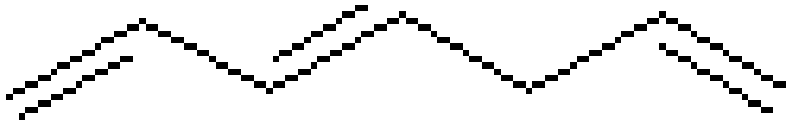
ALKENES

IUPAC naming system:

Name the following alkenes:



4-methylpenta-1,3-diene



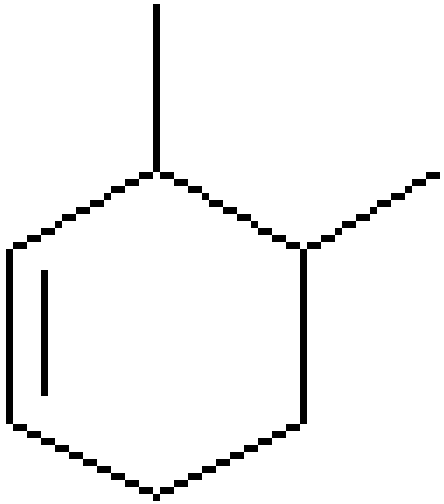
(3*E*)-hepta-1,3,6-triene

*When there is more than one double bond, add the letter "a" to the end of the prefix (i.e. but**a**)*

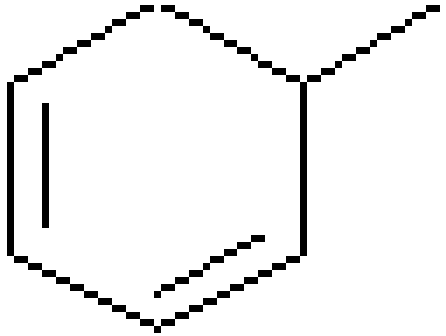
ALKENES

IUPAC naming system:

Name the following alkenes:



3,4-dimethylcyclohexene

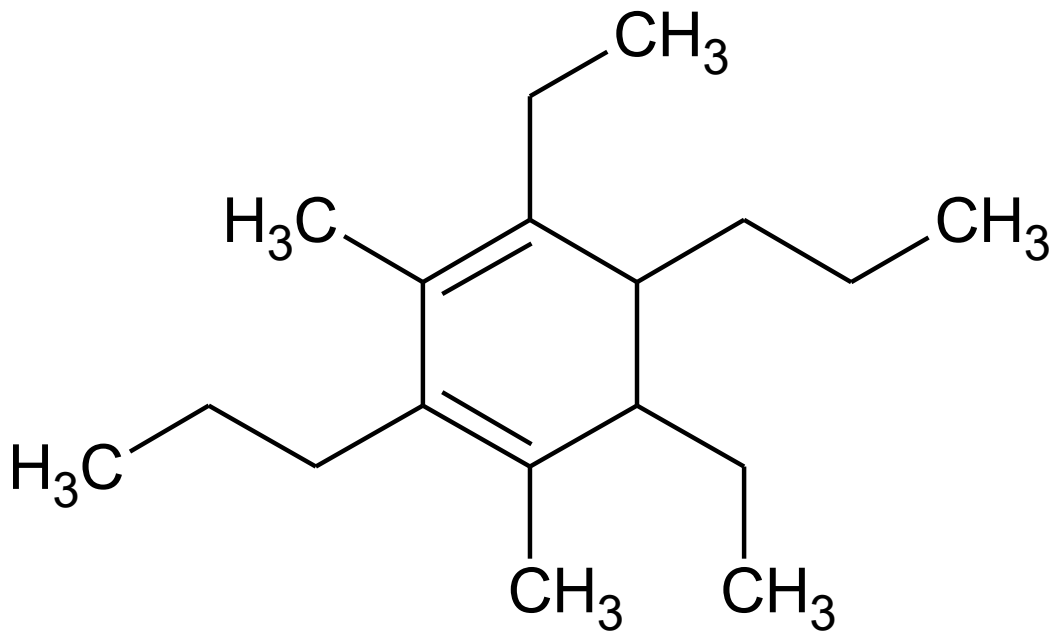


5-methylcyclohexa-1,3-diene

ALKENES

IUPAC naming system:

Name the following alkene:



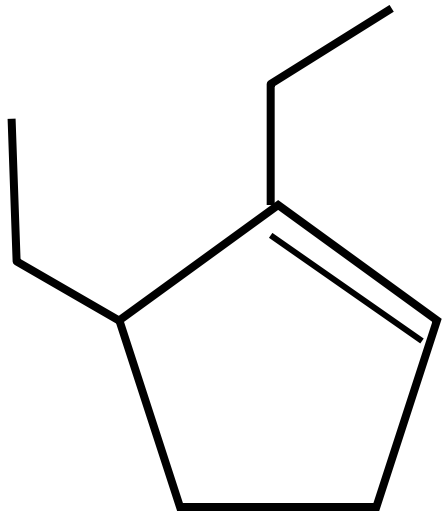
1,5-diethyl-2,4-dimethyl-3,6-dipropylcyclohexa-1,3-diene

ALKENES

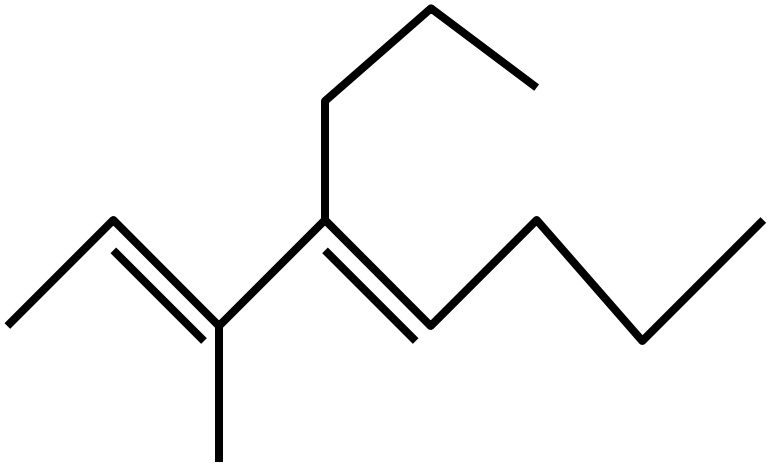
Drawing alkenes:

Draw the following alkenes using line diagrams

2,3-diethylcyclopentene



(2*E*,4*E*)-3-methyl-4-propylocta-2,4-diene

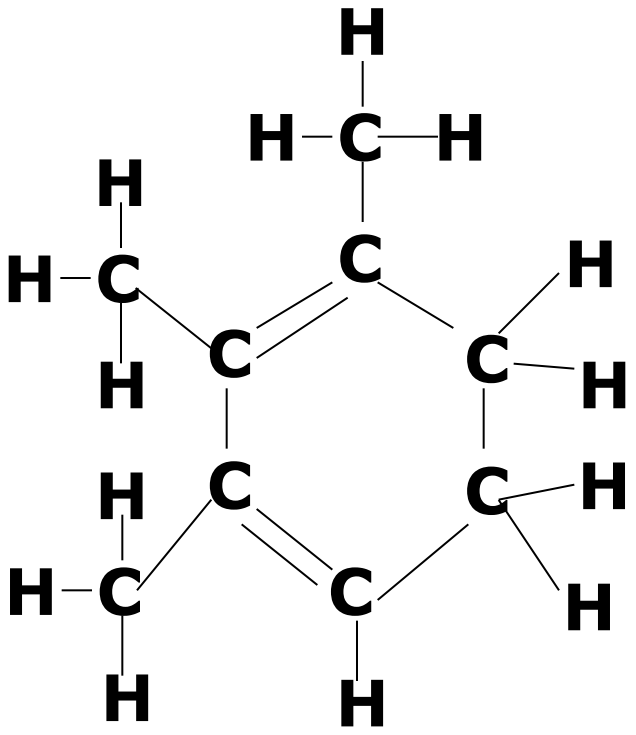


ALKENES

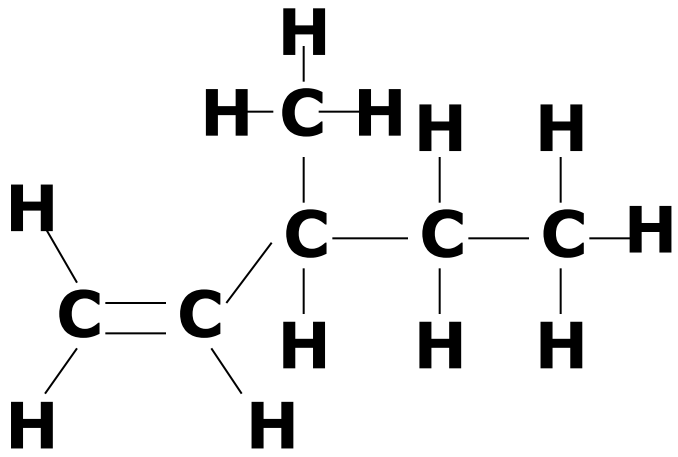
Drawing alkenes:

Draw the following alkenes using structural diagrams

1,2,3-trimethylcyclohexa-1,3-diene



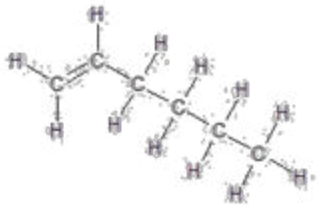
3-methylpent-1-ene



ALKENES

Properties:

-Are hydrophobic like all hydrocarbons

-*terminal* alkenes (ex. ) have slightly lower boiling points than their alkane counterparts, but *cis*, *trans,* and *cyclic* alkenes have slightly higher boiling points.

Formula	B.p., °C
$CH_2{=}CH_2$	−102
$CH_2{=}CHCH_3$	−48
$CH_2{=}CHCH_2CH_3$	−6.5
$CH_2{=}CH(CH_2)_2CH_3$	30
$CH_2{=}CH(CH_2)_3CH_3$	63.5
$CH_2{=}CH(CH_2)_4CH_3$	93
$CH_2{=}CH(CH_2)_5CH_3$	122.5

ethane	$C_2H_{6(g)}$	**-88**
propane	$C_3H_{8(g)}$	**-42**
butane	$C_4H_{10(g)}$	**0**
pentane	$C_5H_{12(l)}$	**+36**
hexane	$C_6H_{14(l)}$	**+68**
heptane	$C_7H_{16(l)}$	**+98**
octane	$C_8H_{18(l)}$	**+126**

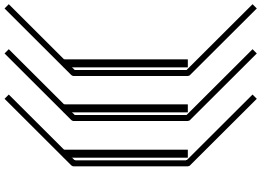
ALKENES

Properties:

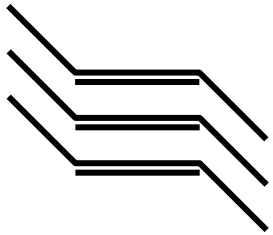
-*cis* and *trans* alkenes have slightly higher boiling points than their alkane counterparts

-this is due to their increased ability to stack together and form London Dispersion Forces (*cis* generally stacks better and has higher boiling points)

Formula	B.p., °C
cis-$CH_3CH{=}CHCH_3$	4
trans-$CH_3CH{=}CHCH_3$	1
cis-$CH_3CH{=}CHCH_2CH_3$	37
trans-$CH_3CH{=}CHCH_2CH_3$	36



cis



trans

ALKENES

Homework:

Page 21 #1, 2 (includes alkynes)
Page 27 #2-5