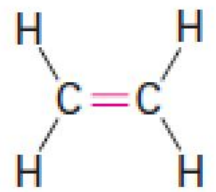
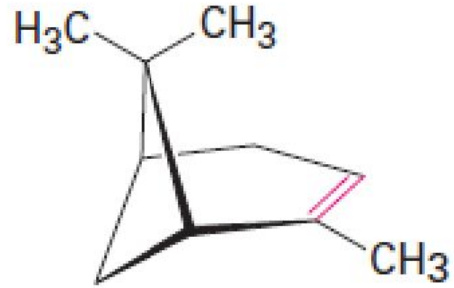
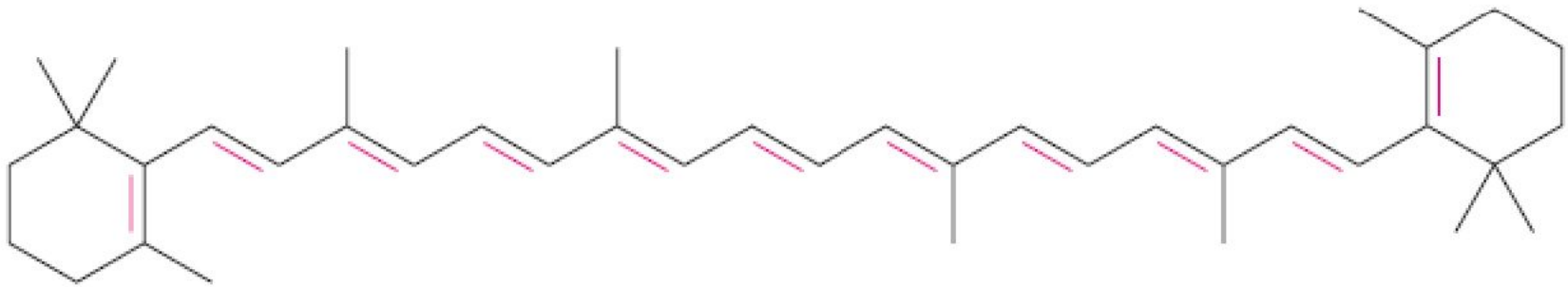
# **Алкены-1**
(строение, изомерия, номенклатура)



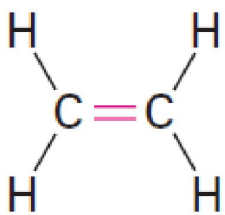

Ethylene

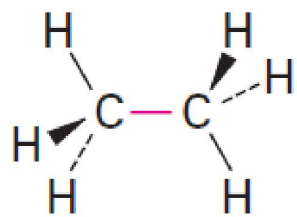



α-Pinene



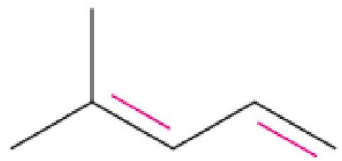
β-Carotene
(orange pigment and vitamin A precursor)



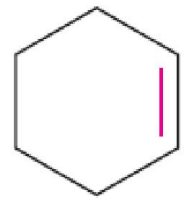



$C_nH_{2n}$

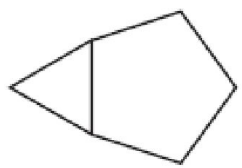
$C_6H_{10}$



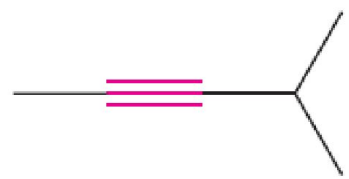
4-Methyl-1,3-pentadiene
(two double bonds)



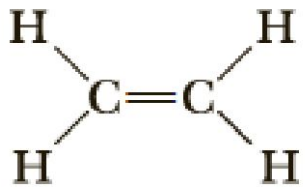
Cyclohexene
(one ring, one
double bond)



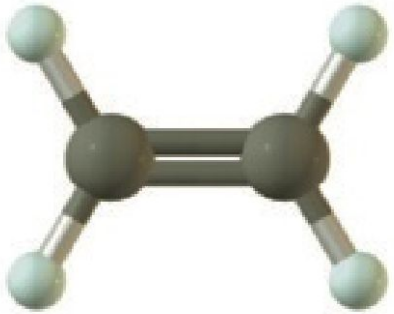
Bicyclo[3.1.0]hexane
(two rings)



4-Methyl-2-pentyne
(one triple bond)

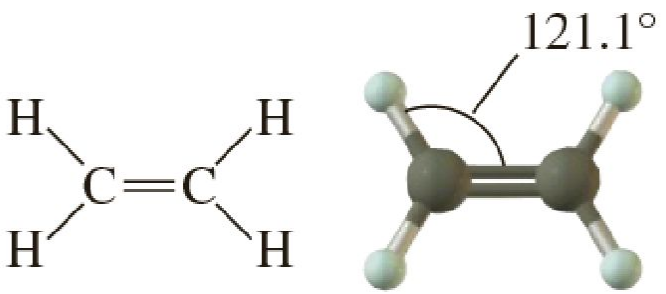



**Ethylene**
(an alkene)

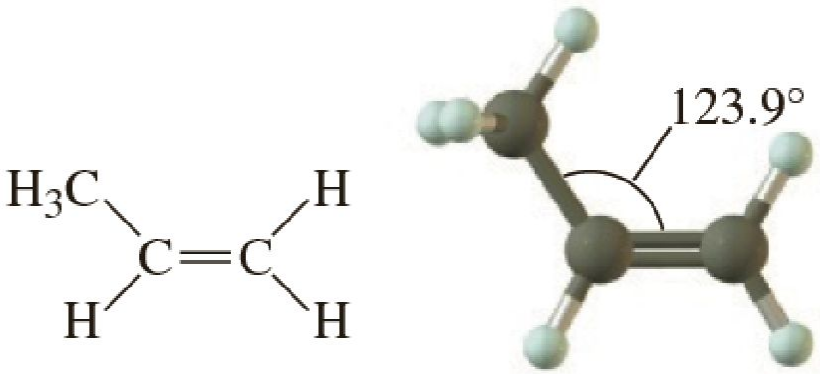


Side view

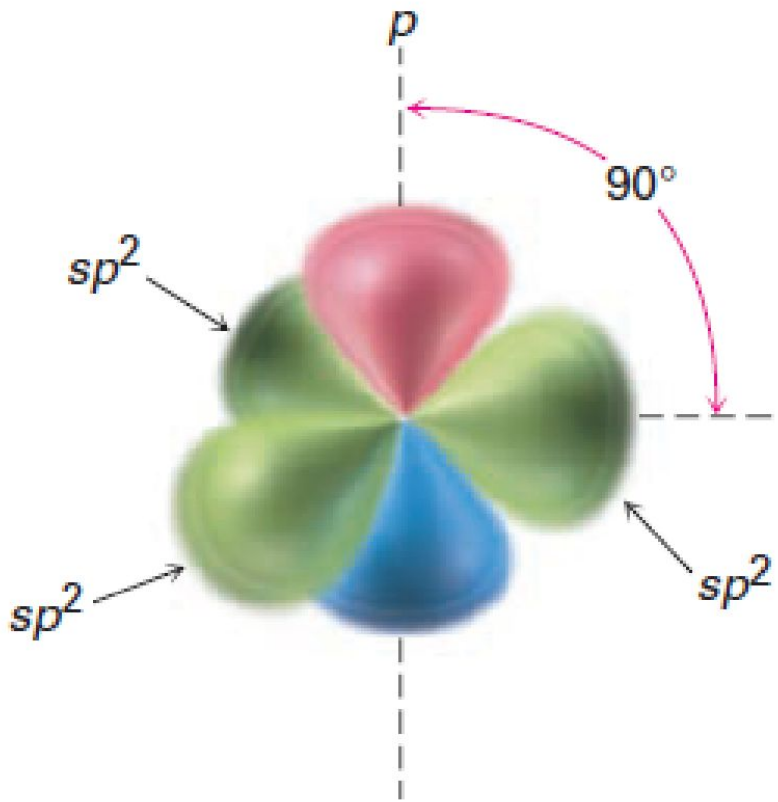
End view



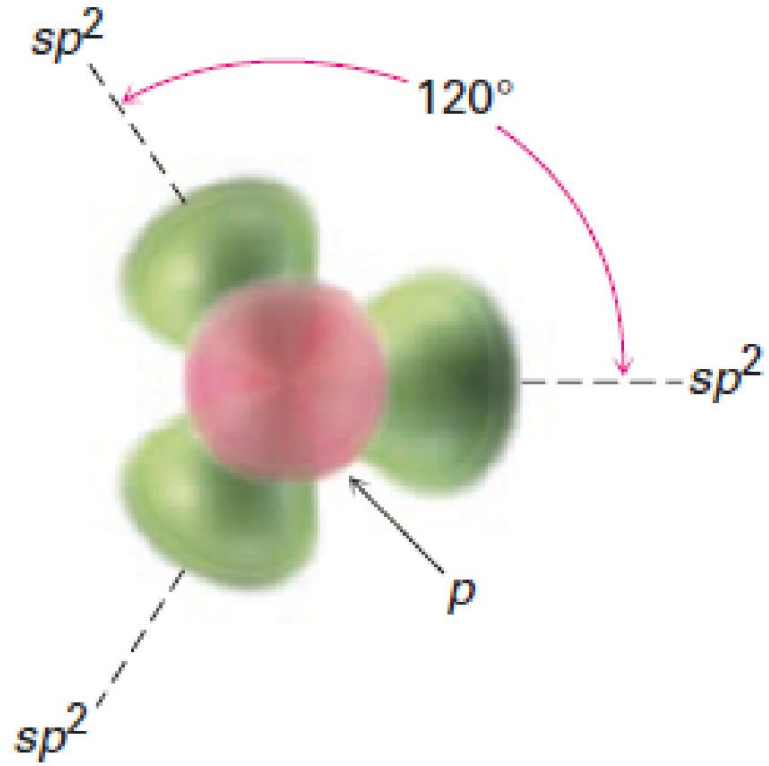

**Ethylene**

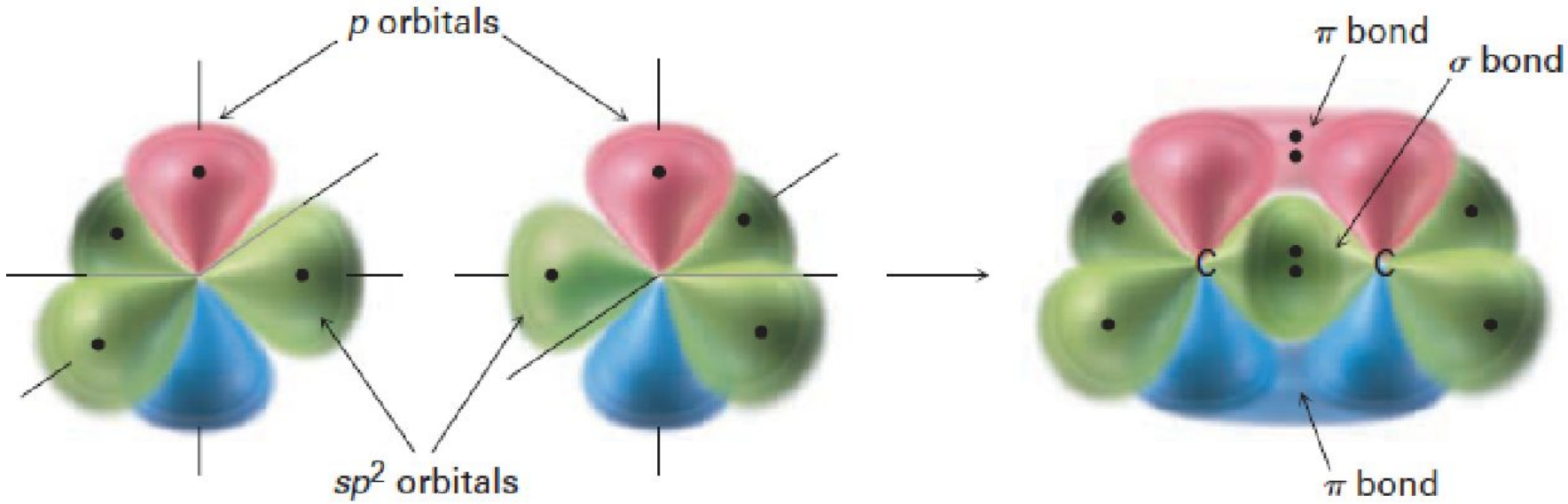


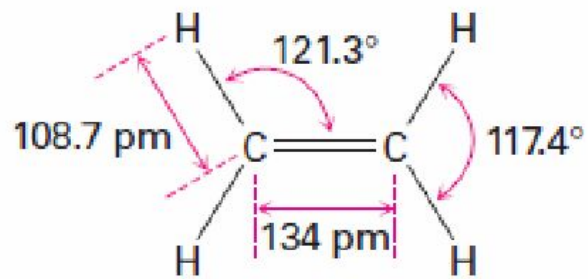

**Propene**



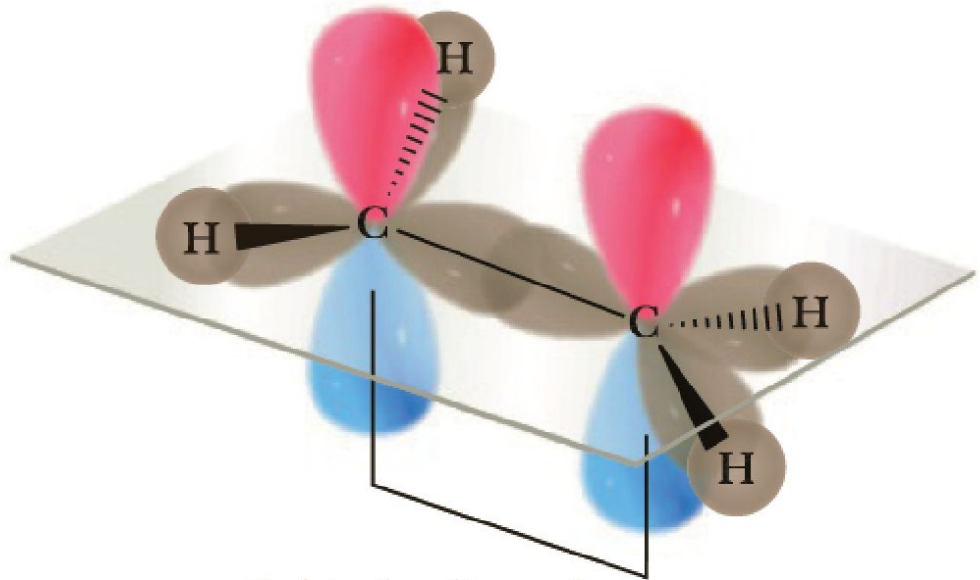

Side view




p orbitals
sp2 orbitals
π bond
σ bond
C
C
π bond
sp2 carbon
sp2 carbon
Carbon–carbon double bond


H
121.3°
H
108.7 pm
C
C
117.4°
134 pm
H
H

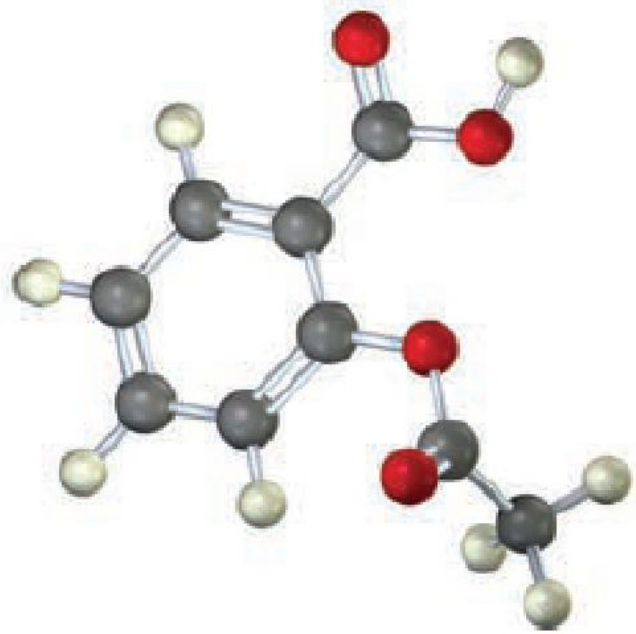
(a)



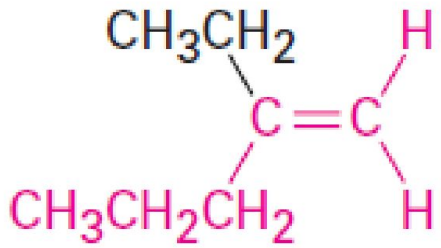

Orbitals aligned.
Good overlap forms
a $\pi$ bond.

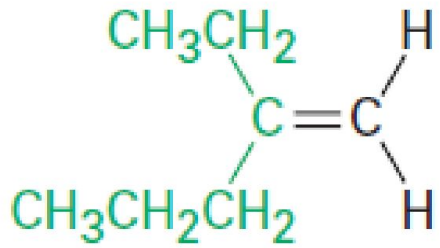
***Problem 1.12***

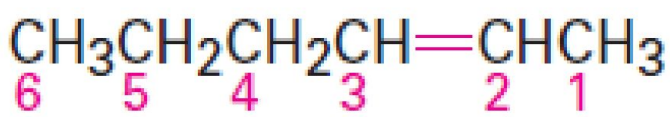
Following is a molecular model of aspirin (acetylsalicylic acid). Identify the hybridization of the orbitals on each carbon atom in aspirin, and tell which atoms have lone pairs of electrons (gray = C, red = O, ivory = H).

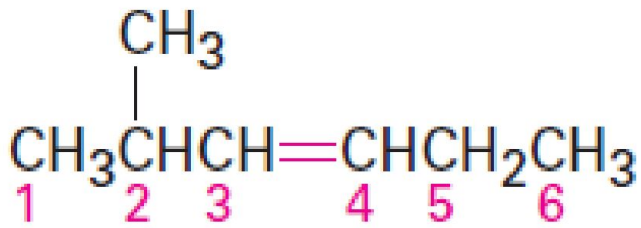


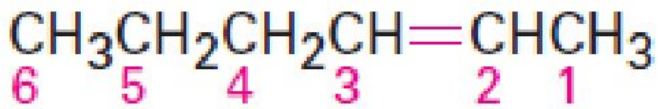
**Aspirin**
**(acetylsalicylic acid)**


CH3CH2
H
C
C
CH3CH2CH2
H

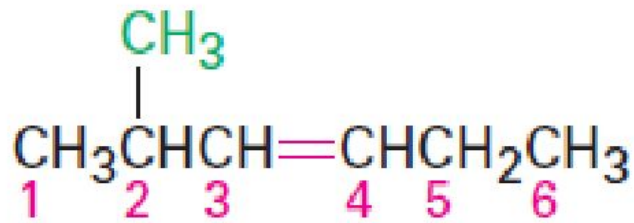

CH3CH2
H
C
C
CH3CH2CH2
H


CH3CH2CH2CH=CHCH3
6 5 4 3 2 1

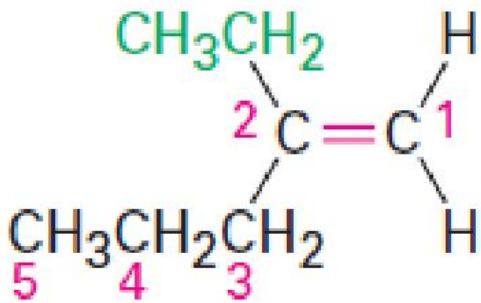

CH3
CH3CHCH=CHCH2CH3
1 2 3 4 5 6



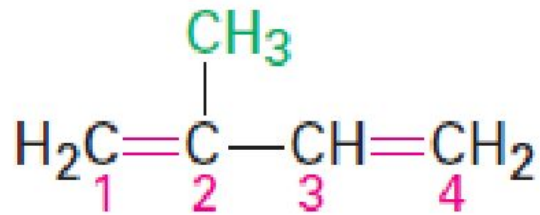

**2-Hexene**



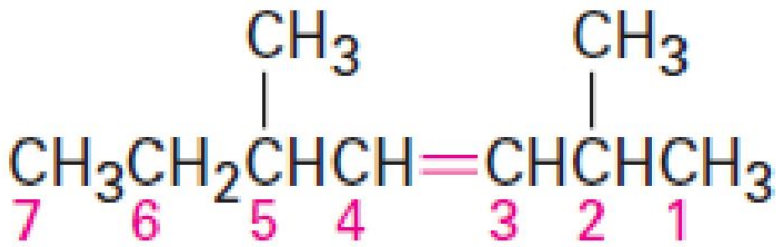

**2-Methyl-3-hexene**




**2-Ethyl-1-pentene**

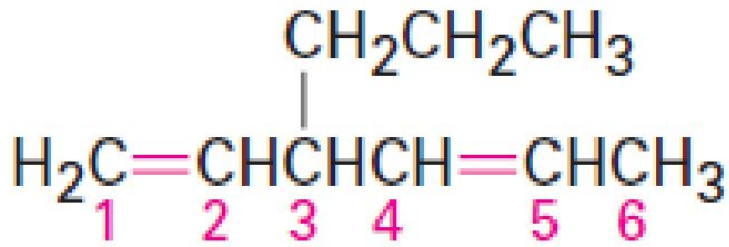



**2-Methyl-1,3-butadiene**



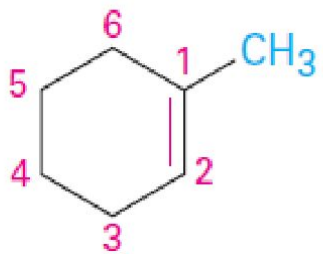

**2,5-Dimethyl-3-heptene**

**2,5-Dimethylhept-3-ene**

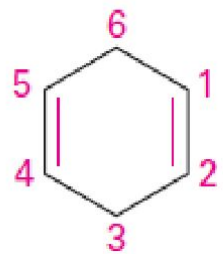



**3-Propyl-1,4-hexadiene**

**3-Propylhexa-1,4-diene)**

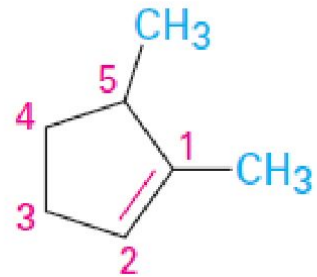



**1-Methylcyclohexene**



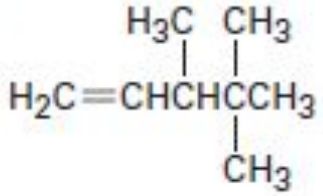

**1,4-Cyclohexadiene**

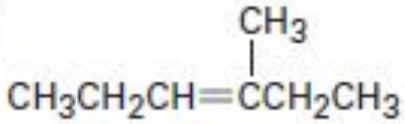
**(New: Cyclohexa-1,4-diene)**

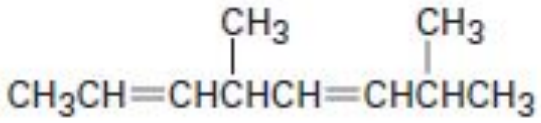


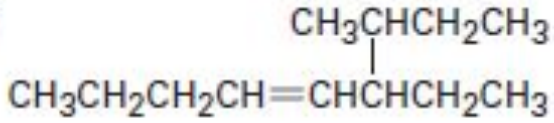

**1,5-Dimethylcyclopentene**

Give IUPAC names for the following compounds:

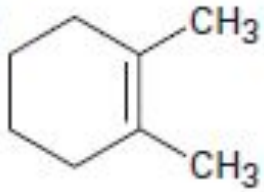
(a) 

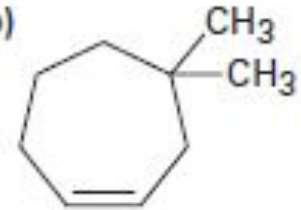
(b) 

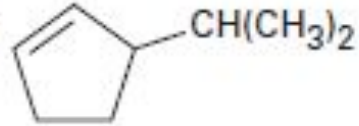
(c) 

(d) 

Name the following cycloalkenes:

(a) 

(b) 

(c) 

Draw structures corresponding to the following IUPAC names:

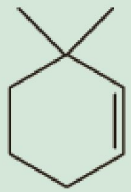
**(a)** 2-Methyl-1,5-hexadiene

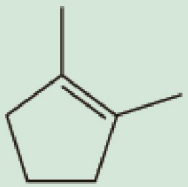
**(b)** 3-Ethyl-2,2-dimethyl-3-heptene

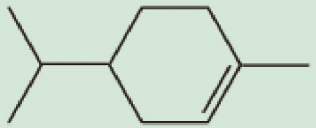
**(c)** 2,3,3-Trimethyl-1,4,6-octatriene

**(d)** 3,4-Diisopropyl-2,5-dimethyl-3-hexene

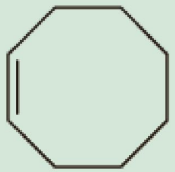
Write the IUPAC name of each cycloalkene.

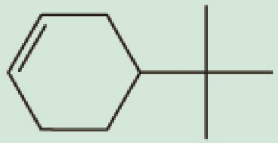
(a) 

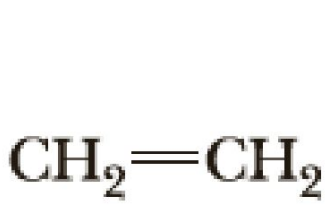
(b) 

(c) 

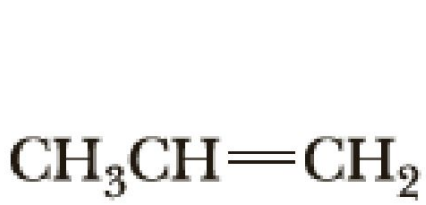
(a) 

(b) 

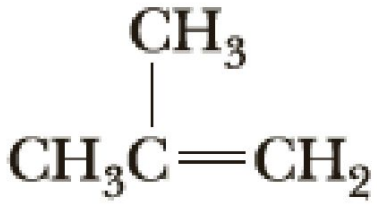
(c) 



**Ethene**
**Ethylene**



**Propene**
**Propylene**



**2-Methylpropene**
**Isobutylene**

## Methylene

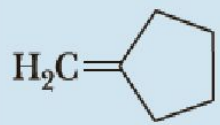
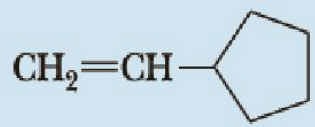
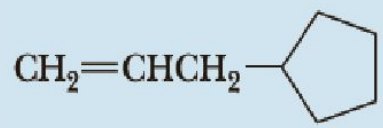
A $CH_2=$ group.

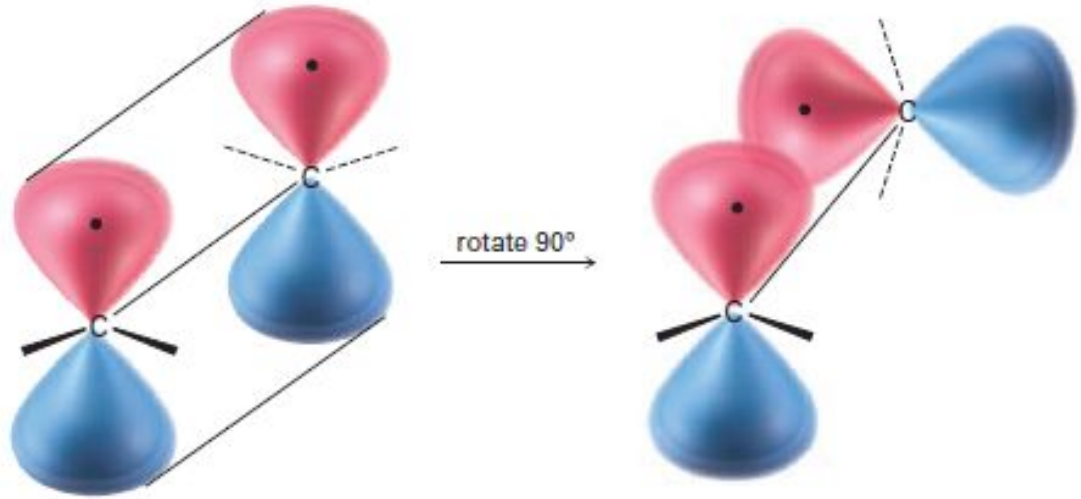
## Vinyl

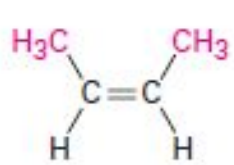
A $CH_2=CH-$ group.

## Allyl

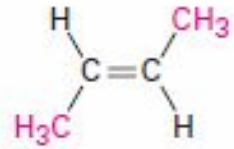
A $CH_2=CHCH_2-$ group.

| Alkenyl Group | IUPAC Name | Common Name | Example | IUPAC Name (Common Name) |
|---|---|---|---|---|
| $CH_2=$ | Methylidene | Methylene |  | Methylidenecyclopentane (Methylenecyclopentane) |
| $CH_2=CH-$ | Ethenyl | Vinyl |  | Ethenylcyclopentane (Vinylcyclopentane) |
| $CH_2=CHCH_2-$ | 2-Propenyl | Allyl |  | 2-Propenylcyclopentane (Allylcyclopentane) |

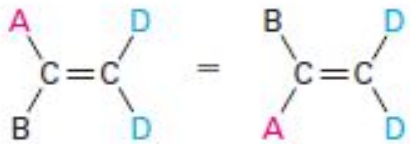


*cis*-2-Butene



*trans*-2-Butene



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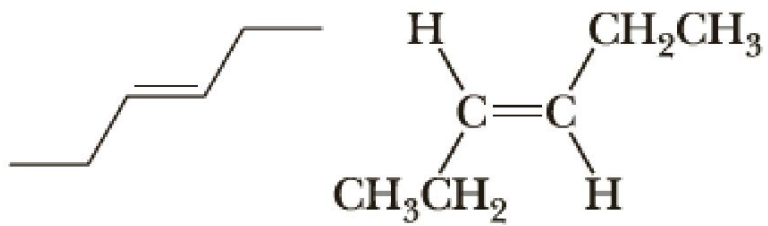
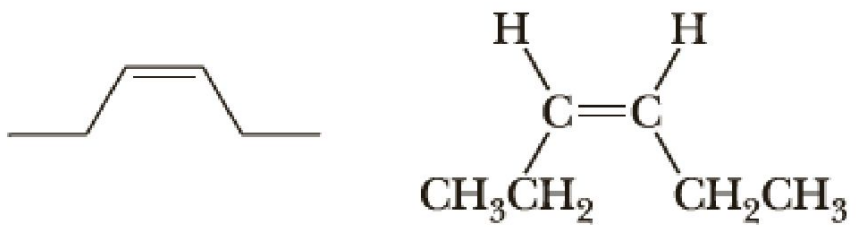
These two compounds are identical; they are not cis–trans isomers.

≠

These two compounds are not identical; they are cis–trans isomers.




*trans*-3-Hexene



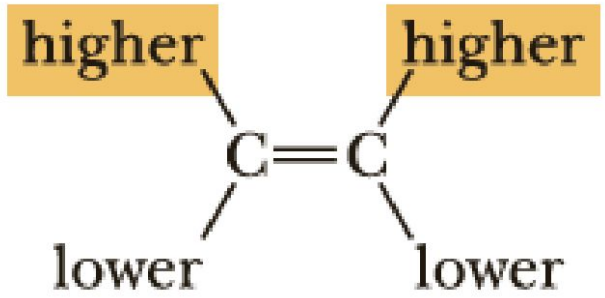

*cis*-3-Hexene

Which of the following compounds can exist as pairs of cis–trans isomers? Draw each cis–trans pair, and indicate the geometry of each isomer.

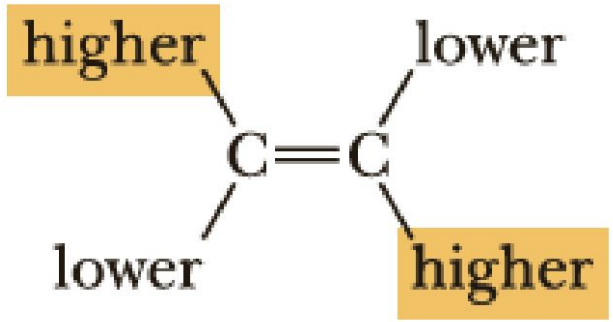
**(a)** $CH_3CH{=}CH_2$ **(b)** $(CH_3)_2C{=}CHCH_3$

**(c)** $CH_3CH_2CH{=}CHCH_3$ **(d)** $(CH_3)_2C{=}C(CH_3)CH_2CH_3$

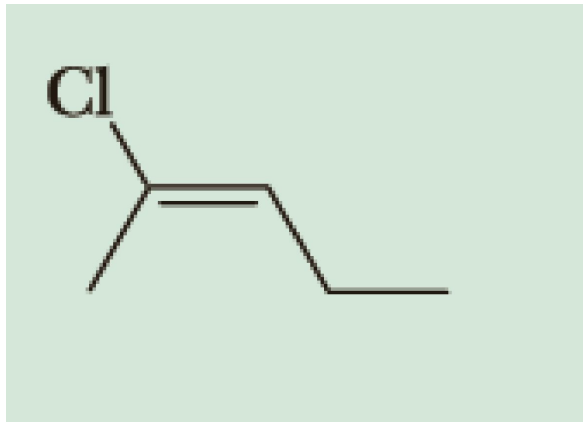
**(e)** ClCH=CHCl **(f)** BrCH=CHCl

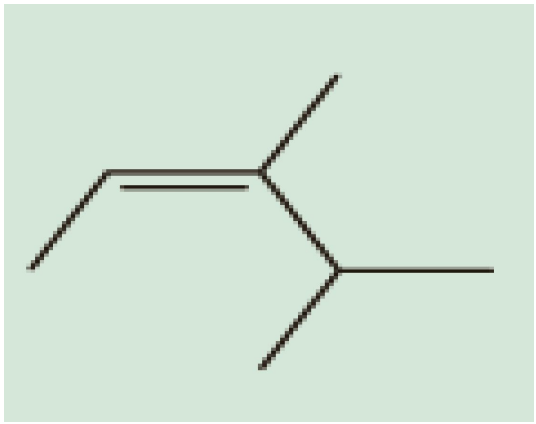



*Z* (*zusammen*)



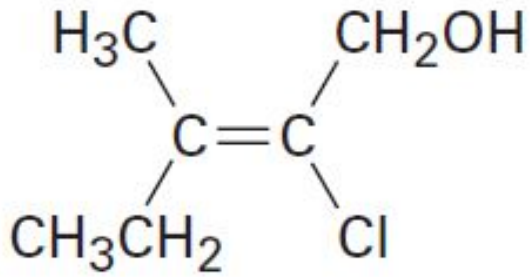

*E* (*entgegen*)



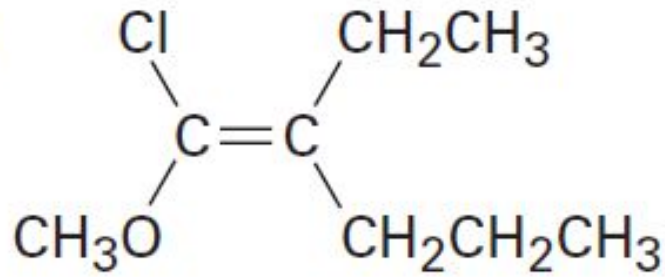



Assign *E* or *Z* configuration to the following alkenes:

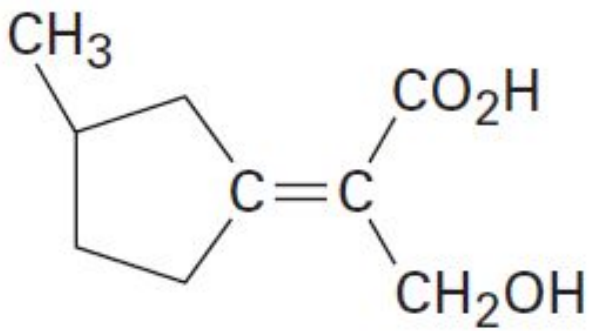
**(a)**



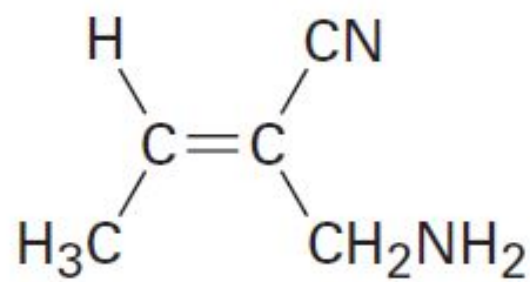

**(b)**




**(c)**

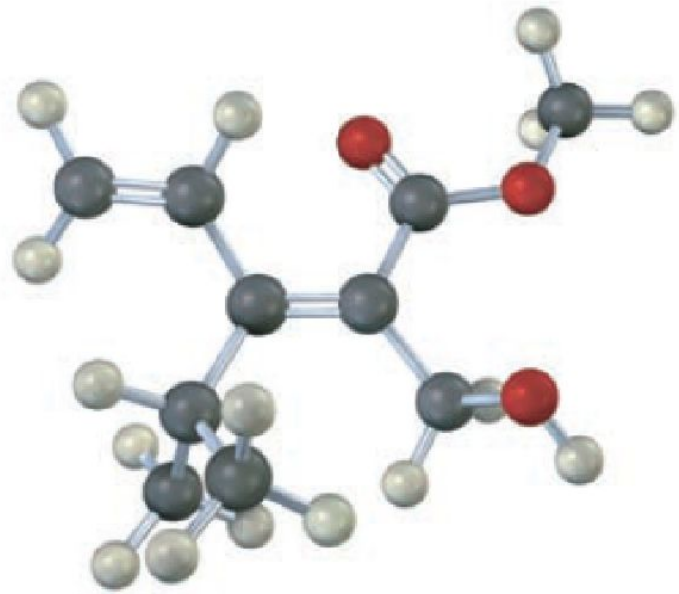


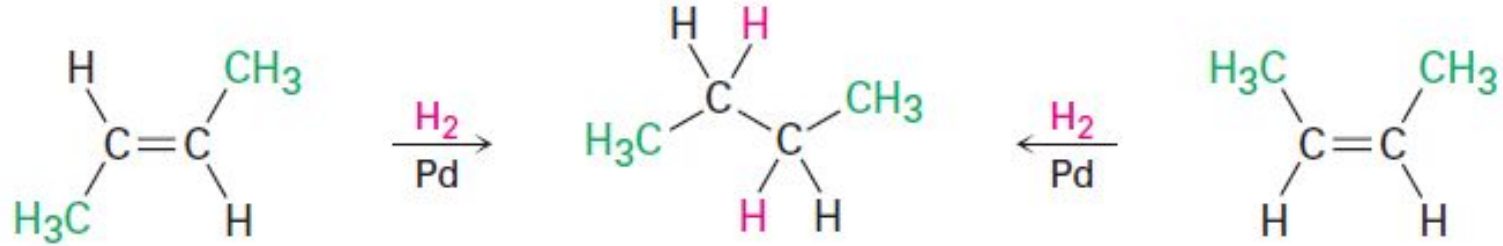

**(d)**



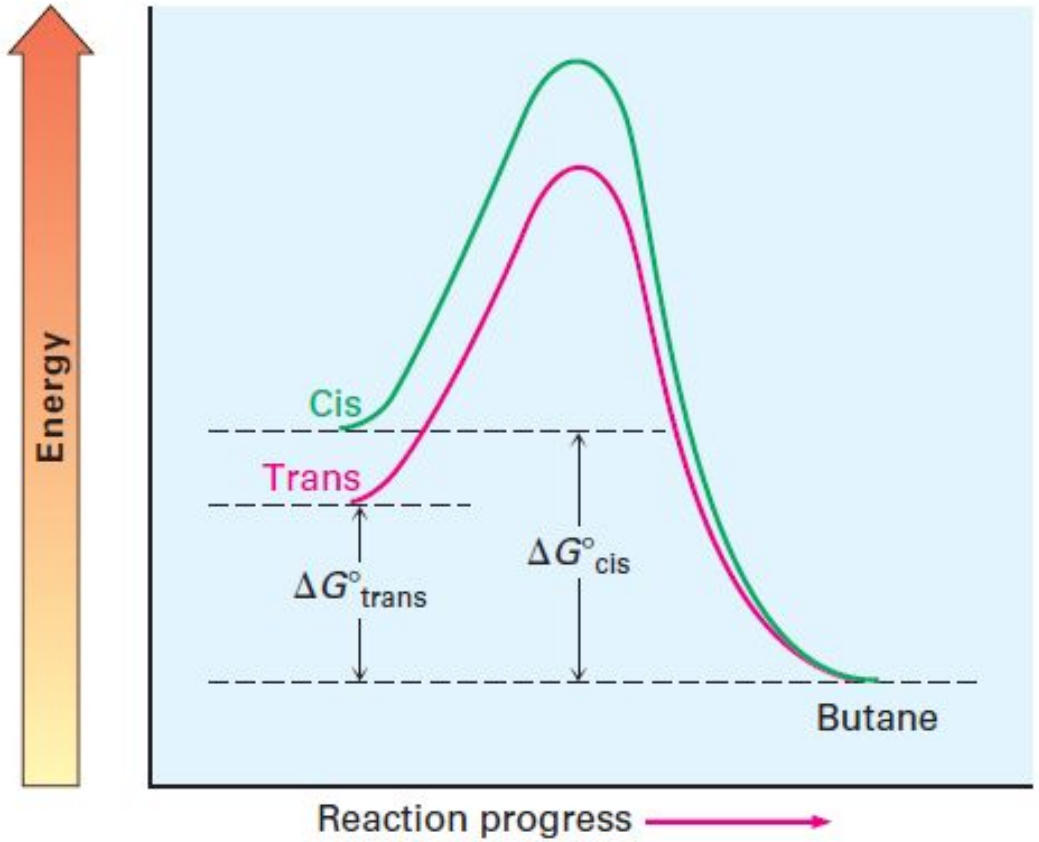
## *Problem 7.14*

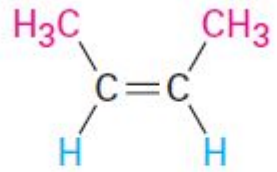
Assign stereochemistry (*E* or *Z*) to the double bond in the following compound, and convert the drawing into a skeletal structure (red = O):



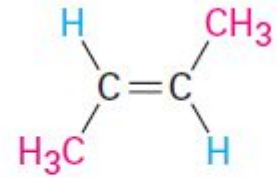



***trans*-2-Butene** **Butane** ***cis*-2-Butene**

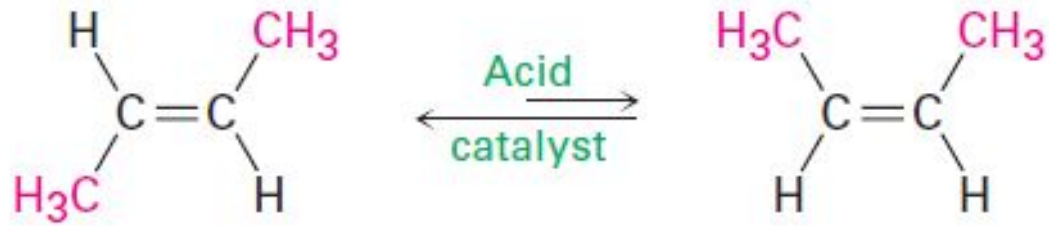


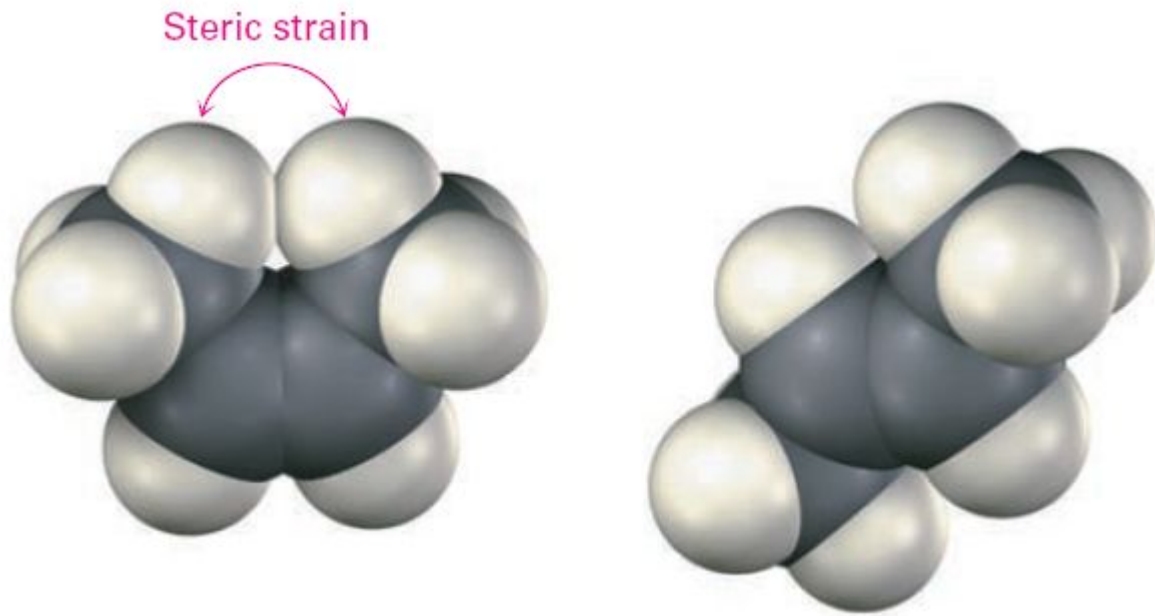

**Cis isomer**
$\Delta H°_{hydrog} = -120$ kJ/mol




**Trans isomer**
$\Delta H°_{hydrog} = -116$ kJ/mol



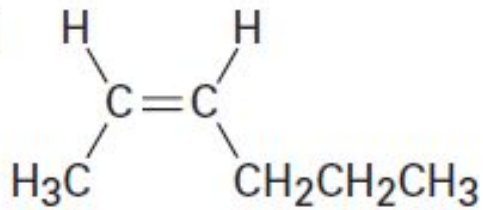

**Trans (76%)** **Cis (24%)**



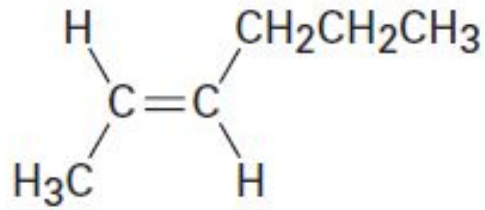
Name the following alkenes, and tell which compound in each pair is more stable:

**(a)** $H_2C{=}CHCH_2CH_3$ or $H_2C{=}C(CH_3)CH_3$

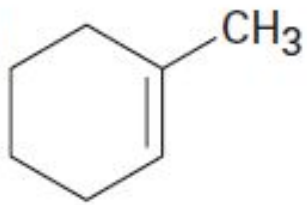
**(b)**




or




**(c)**




or