Chap 7

Alkenes

1. General information-

Alkenes = c=c, 1.33 A sigma bonds - 20 kcal/mol more stable, so π bonds more reactive.

2. Degrees of unsaturation, (sat. all H)

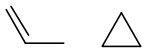
1 degree of unsaturation = 1 ring, 1 double bond

2 degree of unsaturation = 2 rings, 2 double bonds, 1 double bond and 1 ring, 1 triple bond

Calculate degrees of unsaturation

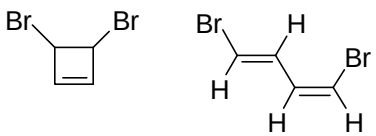
$$\frac{(2C + 2) - H}{2} =$$

$C_3H_6 = [(2(3) + 2) - 6]/2 = 1$



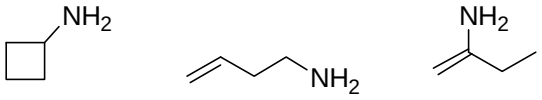
If formula contains a halogen add 1 H to the total.

$C_4H_4Br_2 = C_4H_6 = [(2(4) + 2) - 6]/2 = 2$



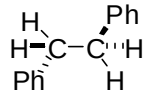
If formula contains a nitrogen add 1 H and 1 C to the total.

$C_4H_9N = C_5H_{10} = [(2(5) + 2) - 10]/2 = 1$

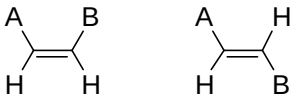


3. Stereoisomers

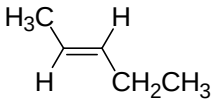
A) -cis -trans, must have a rigid system.



Not cis or trans

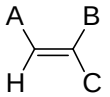


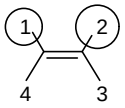
cis trans



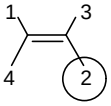
trans-2-pentene

B) E, Z system Z = zusammen, together E = entegen, opposite





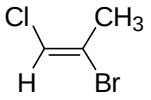
Z same side



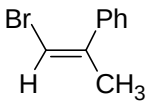
E opposite side

Not cis- or tans-

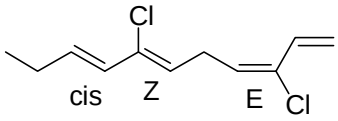
Prioritize each side of the double bond use R- and S- priority rules.



E-2-bromo-1-chloropropene



Z-1-bromo-2-phenylpropene

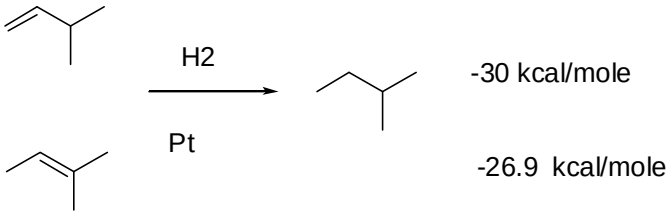


4. Stability of alkenes- measured by heat of hydration.

$R_2C{=}CR_2 + H_2 \rightarrow R_2HC{=}CHR_2 +$ heat about 20-30 kcal/mole

more negative the more unstable

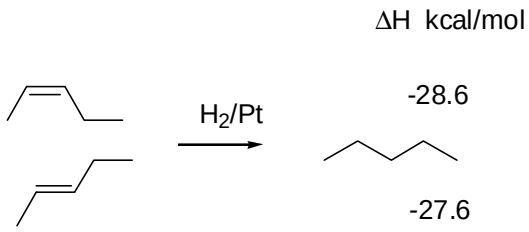
A) substitution effects.



1. More alkyl groups more stable- alkyl groups e' donating
2. Release steric strain.

B) cis- trans-

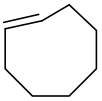
Trans more stable, alkyl groups further apart.



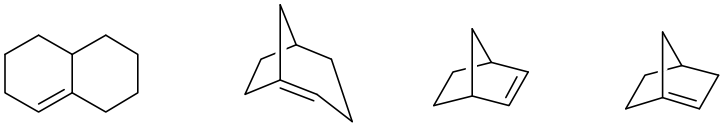
5. Stability of alkenes in rings-

cyclobutane more reactive 90 farther from 109.

Nedd at least 8 carbons for a trans double bond.



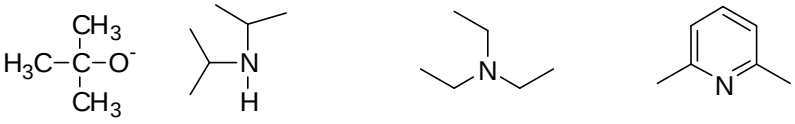
Bredt's rule- A bridged bicyclic compound cannat have a double bond at a bridgehead, unless the ring has 8 carbons or more. Bridgehead carbon atoms are part of both rings with at least 1 carbon in each of the three links.



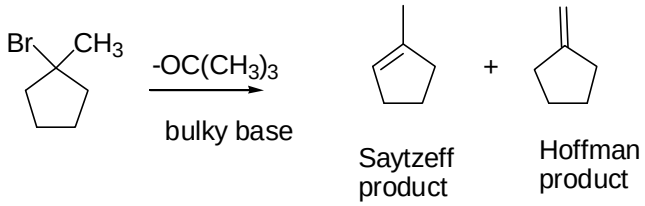
ok, not bridged bad ok bad

6. Formation of double bonds.

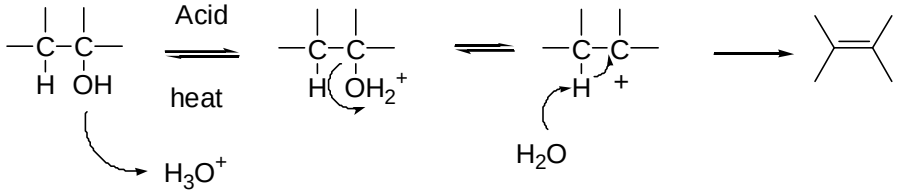
A. Force E2 use a bulky base and 3 > 2> 1 substrate.



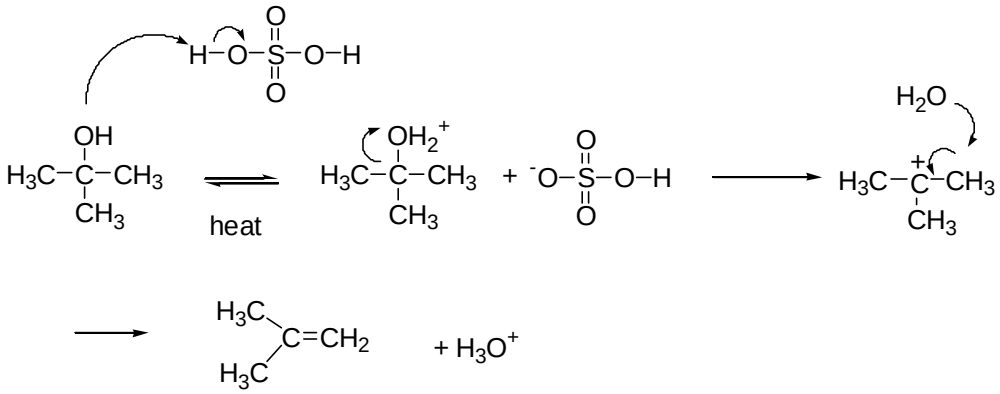
t-butoxide diisopropylamine triethylamine 2,6-dimethylpyridine4



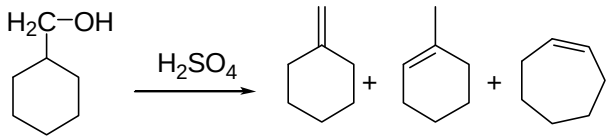
B. Dehydration- removal of water.

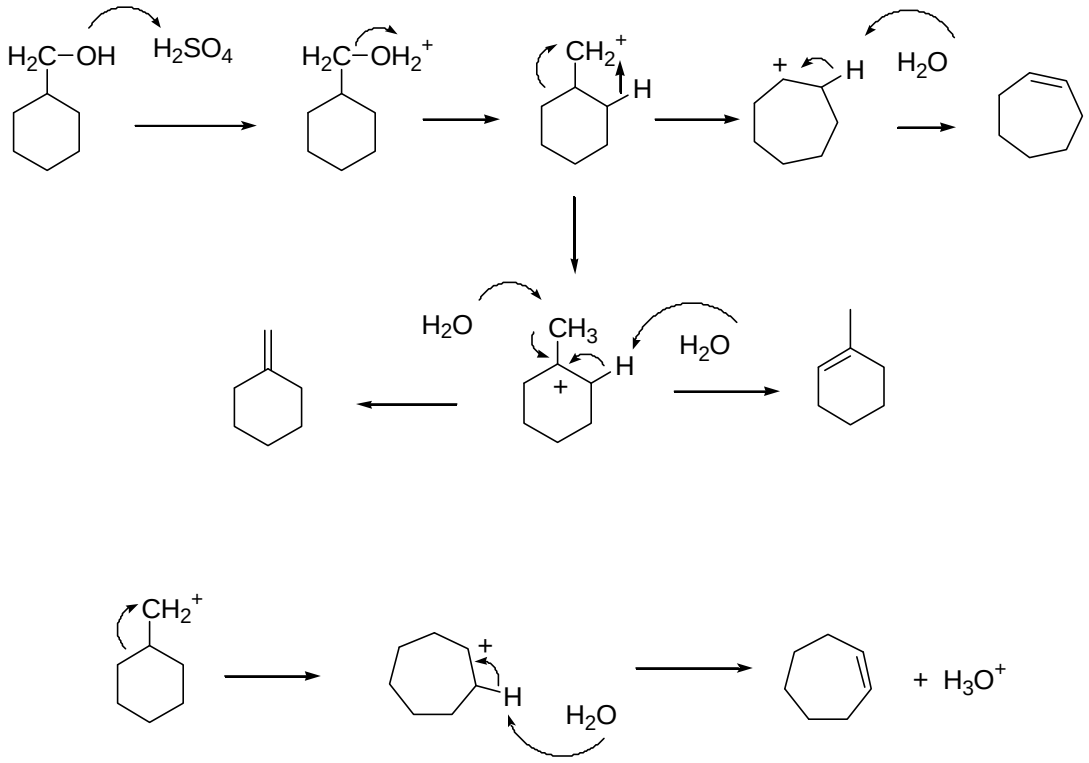


Use distillation to remove alkene (lower b.p.) to force equilibrium.



Problem 7-17b




H2C−OH
H2SO4
H2C−OH2+
CH2+
H
+
H
H2O
H2O
CH3
H
+
H2O
CH2+
+
H
H2O
+ H3O+