Chemistry Department

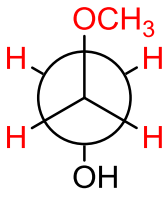
University of Alberta

CHEM 261

Exam II

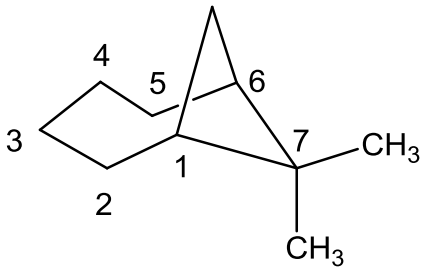
May 20, 2011

1. Using the partial Newman projection structure below, draw the most stable conformation of 2-methoxyethanol. (2 points)



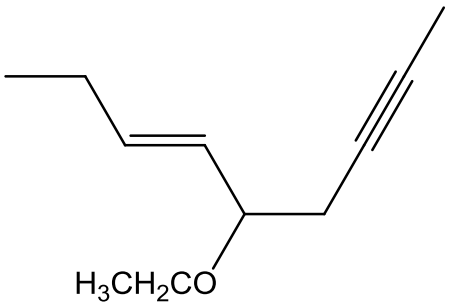
2. Name the following compounds:

   a. (5 points)



7,7-dimethylbicyclo[4.1.1]octane

   b. (5 points)

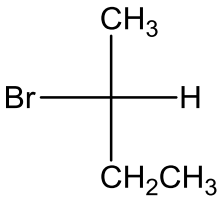


trans-5-ethoxy-6-nonen-2-yne

c. (4 points)

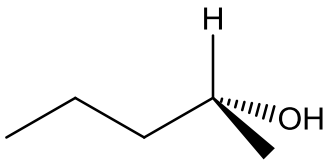
cis-1-isopropyl-3-methylcyclohexane

d. (2 points)



(R)-2-bromobutane

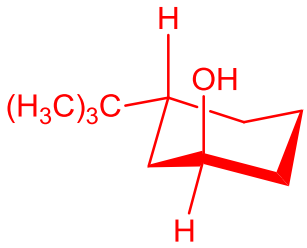
e. (3-points)



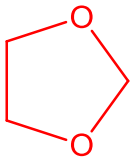
(R)-2-pentanol

3. Draw the structures of the following compounds using any given partial structure:

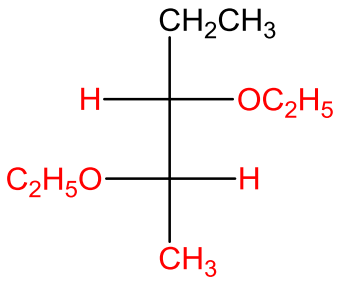
a. *trans*-3-*tert*-butylcyclohexanol (4 points)



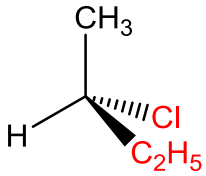
b. 1,3-dioxacyclopentane (3 points)



c. (2S,3S)-2,3-diethoxypentane (5 points)



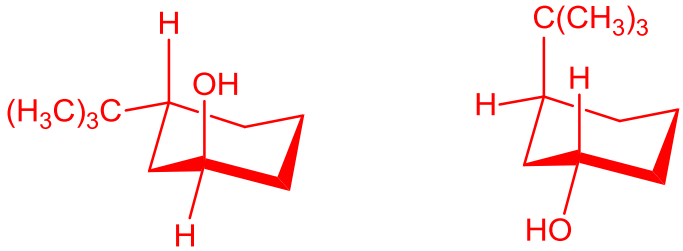
d. (R)-2-chlorobutane (2 points)



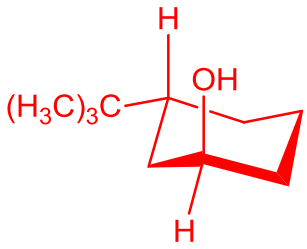
4. The following table lists the steric strain values for one H-substituent 1,3-diaxial interaction. Thus the value of a H-F 1,3-diaxial interaction is 0.5 kJ/mol.

substituent	strain (kJ/mol)	substituent	strain (kJ/mol)
Br-	1.0	C_6H_5-	6.3
CH_3-	3.8	Cl-	1.0
CH_3CH_2-	4.0	CN-	0.4
$(CH_3)_2CH$-	4.6	HO_2C-	2.9
$(CH_3)_3C$-	11.4	F-	0.5
HO-	1.8	H_2N-	2.9

a. Draw the two chair conformations of *trans*-3-*tert*-butylcyclohexanol using the two partial structures. (6 points)

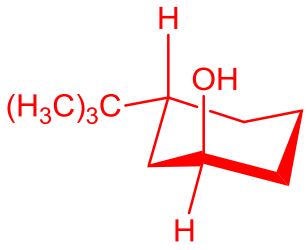


b. Which is the more stable? (1 point)

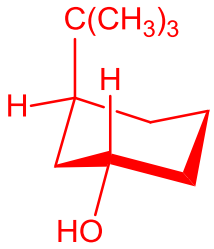


c. Justify your decision using the principles of conformational analysis and calculate the difference in energy between the two structures. (8 points)

They are both free of angle strain and of torsional strain.



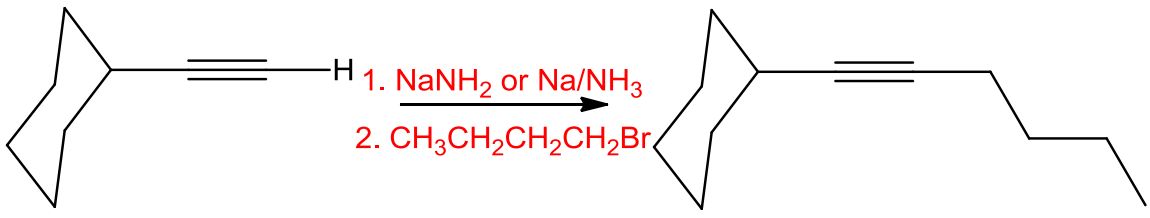
has 2 H – OH 1,3-diaxial interactions for 3.6 kJ/mol of instability whereas



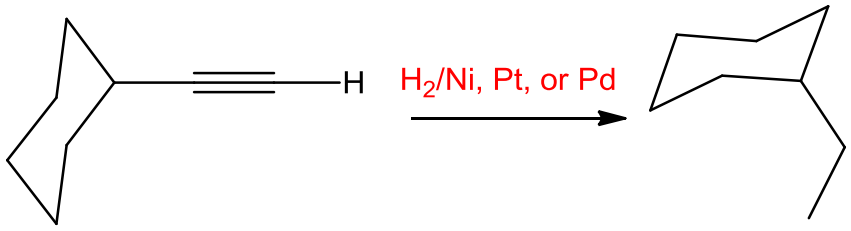
has 2 H – $C(CH_3)_3$ 1,3-diaxial interactions for 22.8 kJ/mol of instability. This structure is 22.8 – 3.6 = 19.2 kJ/mol less stable than the conformation having the equatorial *tert*-butyl group.

5. Specify the reagents in each of the following syntheses (more than one step may be necessary) (9 points)

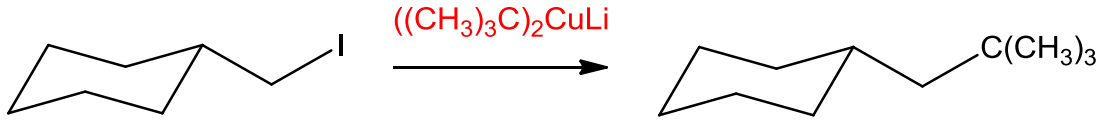
a.



b.

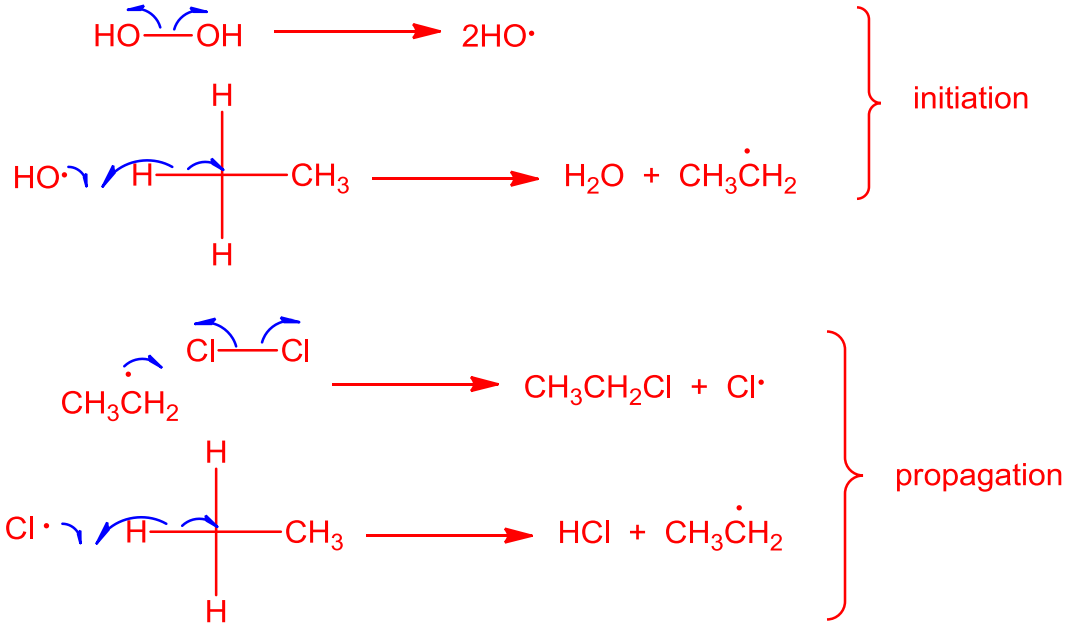


c.



6. Peroxides are often used to initiate free radical reactions because the O-O bond is easily homolytically cleaved. Thus the bond dissociation energy of the O-O bond in hydrogen peroxide (H-O-O-H) is only 213 kJ/mol.

   Propose a mechanism for the hydrogen peroxide (0.2%) initiated reaction of ethane with chlorine to form chloroethane, HCl, and water, the latter in an amount corresponding to the quantity of peroxide used. Termination steps are not required. Don't forget the arrows to show the flow of electrons. (12 points)



7. Sketch the transition state for the following reaction: (4 points)