Chemistry Department

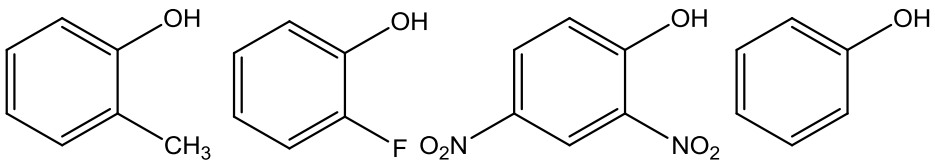
University of Alberta

CHEM 261

Exam II

May 18, 2012

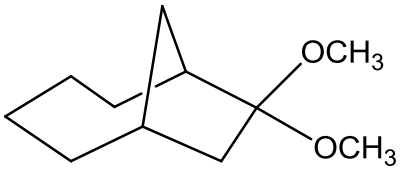
1. The four phenols shown below have pK_a values of 4, 8.8, 10, or 10.2 in random order. Assign the correct pK_a value to each of the compounds. (4 points)



10.2 8.8 4 10

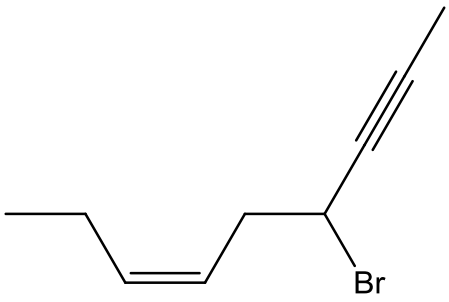
2. Name the following compounds:

   a. (5 points)



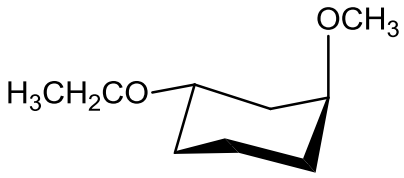
7,7-dimethoxybicyclo[4.2.1]nonane

   b. (5 points)



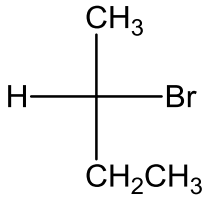
cis-4-bromo-6-nonen-2-yne or *cis*-4-bromonon-6-en-2-yne

c. (4 points)



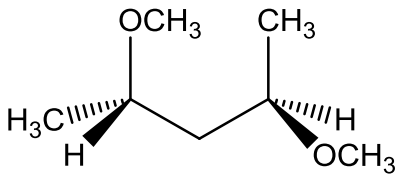
trans-1-ethoxy-3-methoxycyclohexane

d. (2 points)



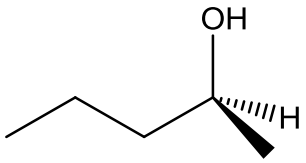
(S)-2-bromobutane

e. (4 points)



meso-2,4-dimethoxypentane

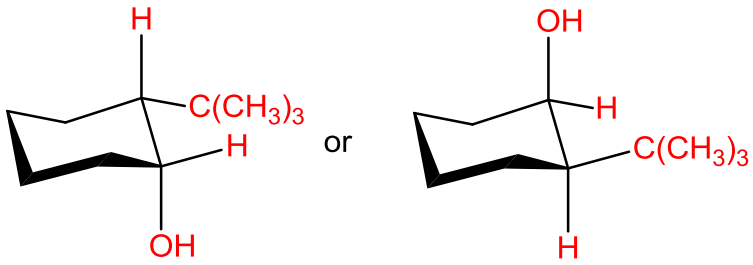
f. (3 points)



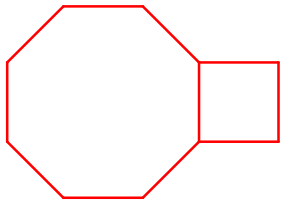
(S)-2-pentanol or (S)-pentan-2-ol

3. Complete the following partial structures of:

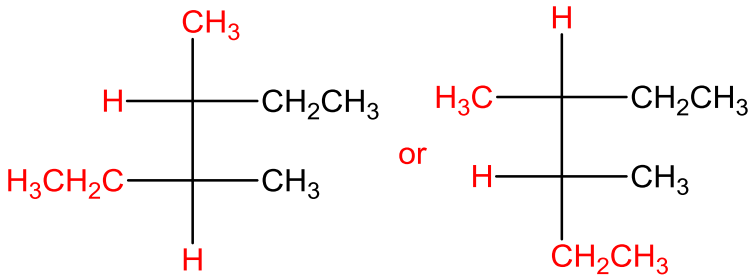
a. *cis*-2-*tert*-butylcyclohexanol (4 points)



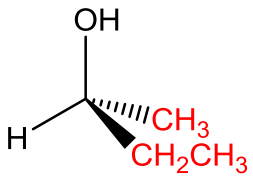
b. bicyclo[6.2.0]decane (2 points)



c. meso-3,4-dimethylhexane: (4 points)



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

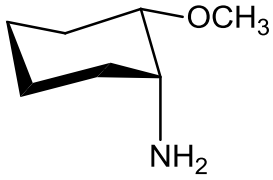


4. The following table lists the steric strain values for one H-substituent 1,3-diaxial interaction. Thus the value of a H-F 1,3-diaxial interaction is 0.5 kJ/mol.

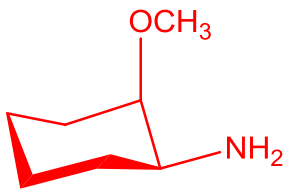
substituent	strain (kJ/mol)	substituent	strain (kJ/mol)
Br-	1.0	C_6H_5-	6.3
CH_3-	3.8	Cl-	1.0
CH_3CH_2-	4.0	CN-	0.4
$(CH_3)_2CH$-	4.6	HO_2C-	2.9
$(CH_3)_3C$-	11.4	F-	0.5
HO-	1.8	H_2N-	2.9
H_3CO-	1.7	H_3CO_2C-	2.7

For each of the following compounds indicate if the molecule is a *cis* isomer or if it is a *trans* isomer and state if it is the most stable conformation possible for the isomer. If it is NOT the most stable, draw the most stable conformation. (9 points)

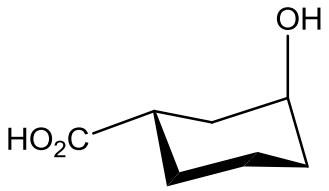
a.



cis, not the more stable, the more stable is:-

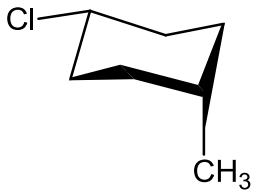


b.

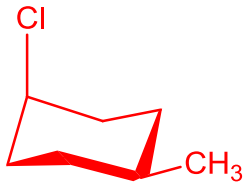


trans, it is the more stable

c.



cis, not the more stable, the more stable is:-



5. Provide a synthetic pathway for the following transformation. Begin your synthesis with the indicated starting material. You can use any additional organic and inorganic reagents. (8 points)

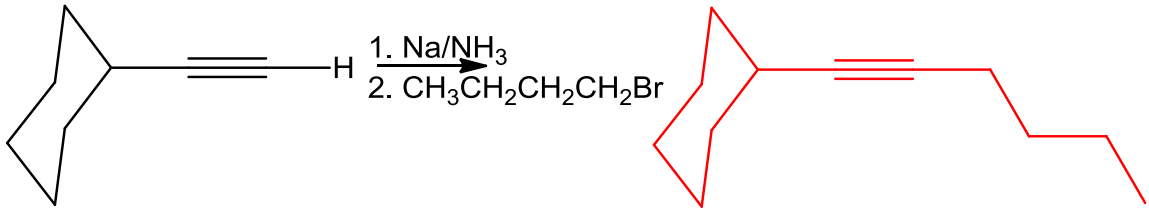
$(CH_3)_3CH \longrightarrow (CH_3)_3CCH_2CH_2CH_2CH_3$

$(CH_3)_3CH \xrightarrow[\text{3. CuI}]{\text{1. } Br_2/h\nu \text{ or } \Delta,\ \text{2. Li}} (CH_3)_3CCH_2CH_2CH_2CH_3$

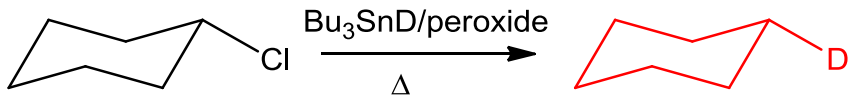
4. $CH_3CH_2CH_2CH_2X$

6. Specify the products in each of the following reactions (4 points)

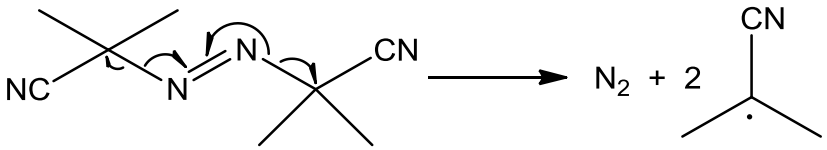
a.



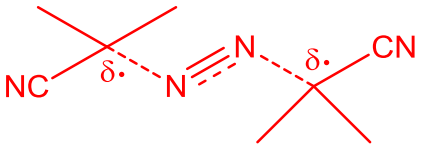
b.



7. AIBN, azobisisobutyronitrile, is an initiator of radical reactions. It undergoes thermal homolysis at 60°C as follows:



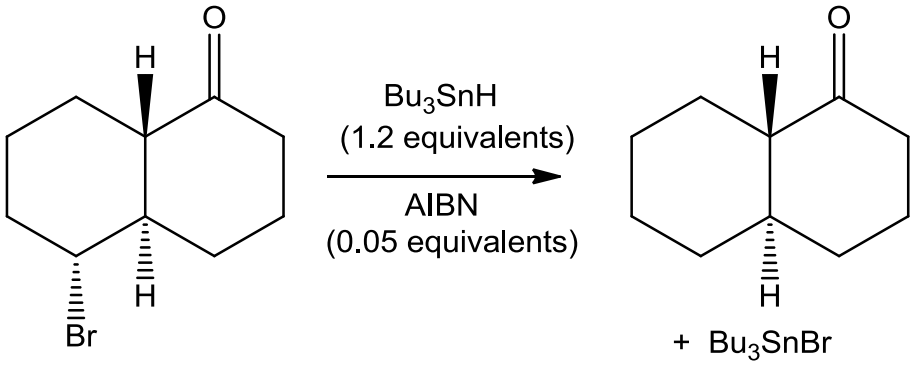
a. Draw the transition state for this process. (2 points)

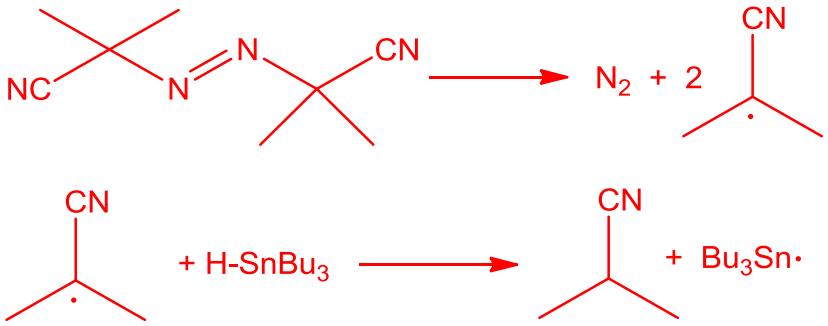


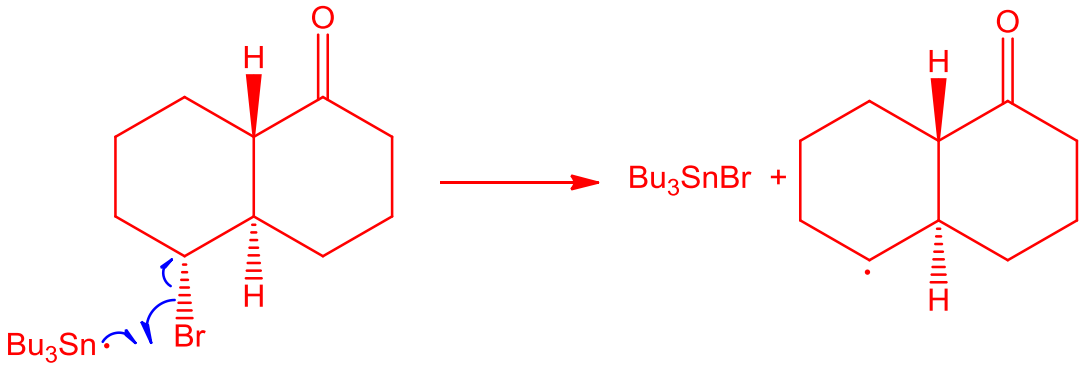
b. Explain the term “chain reaction”. (2 points)

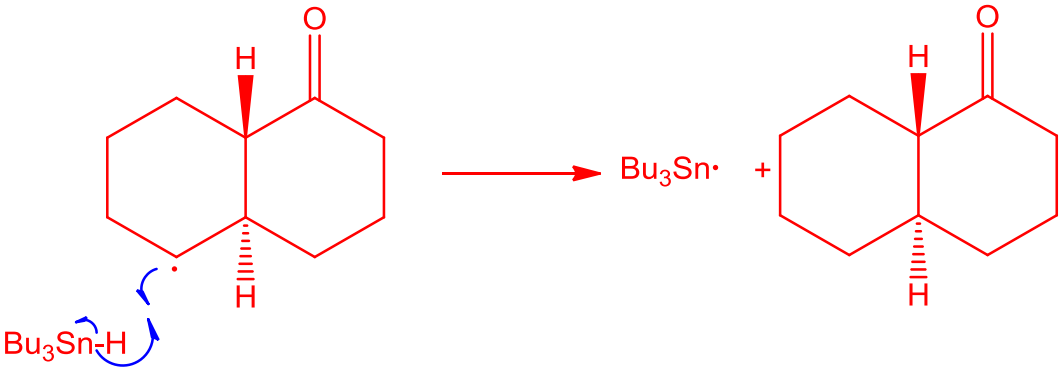
A chain reaction involves a series of steps. Each one generates a reactive species that brings about the next step.

c. The tributylstannane reacts with alkyl halides by a radical, chain mechanism initiated by AIBN. Given the representative bond energies: C – Br 280 kJ/mol, Sn – H 308 kJ/mol, C – H 418 kJ/mol, Sn – Br 552 kJ/mol, propose a mechanism for the following reaction:


O
H
H
Br
Bu3SnH
(1.2 equivalents)
AIBN
(0.05 equivalents)
O
H
H
+ Bu3SnBr


NC
N
N
CN
N2 + 2
CN
CN
+ H-SnBu3
CN
+ Bu3Sn·


O
H
H
Bu3Sn
Br
Bu3SnBr +
O
H
H


O
H
H
Bu3Sn-H
Bu3Sn· +
O
H
H