Chemistry 108A
Fall 2006
Final Exam

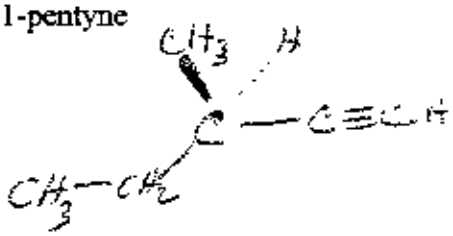
Name Key
Section _____

Problem		Points	Problem		Points
1)	(12 points)	_____	5)	(9 points)	_____
2)	(16 points)	_____	6)	(10 points)	_____
3)	(10 points)	_____	7)	(15 points)	_____
4)	(9 points)	_____	8)	(20 points)	_____
			9)	(50 points)	_____

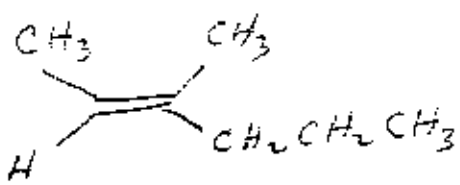
This exam has 9 questions and 14 pages. Check that your exam is complete. Show all work.

1. (*12 points*) provide a structure for the following compounds.

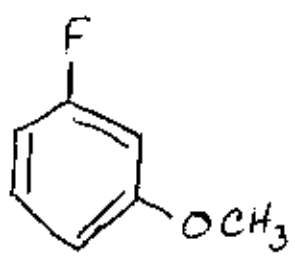
a) (R)-3-methyl-1-pentyne



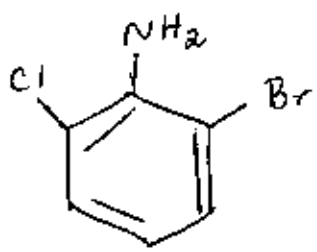
b) (E)-3-methyl-2-hexene



c) *m*-fluoroanisole

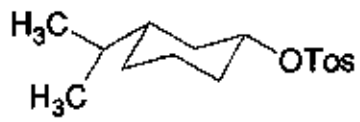


d) 2-bromo-6-chloroaniline

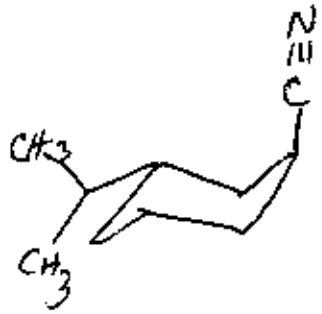


2. (*16 points*) What is the expected major product for each of the following transformations? Indicate stereochemistry when appropriate.

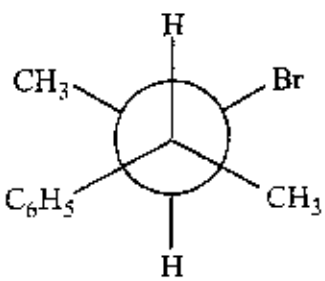
a)



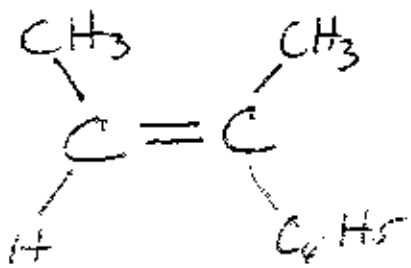
NaCN
DMF
S_N2



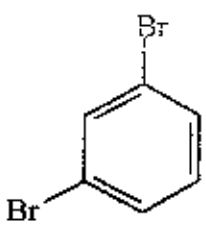
b)



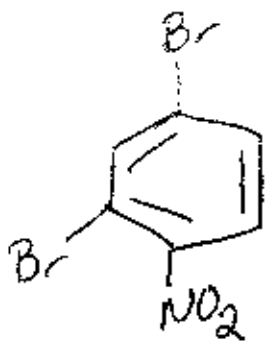
$(CH_3)_3C-O^{\ominus}K^+$
$(CH_3)_3C-OH$
E_2



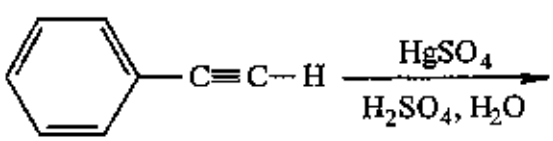
c)



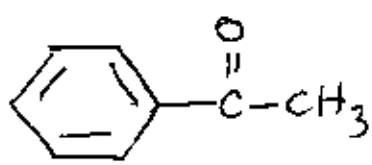
HNO_3
H_2SO_4



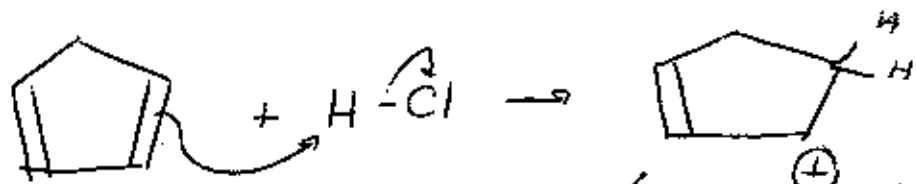
d)



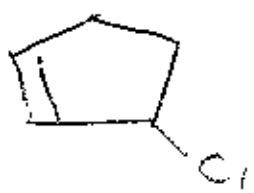
$HgSO_4$
H_2SO_4, H_2O



3. (*10 points*) In the reaction of 1,3-cyclopentadiene with hydrogen chloride at 0°C, no significant amount of 4-chlorocyclopentene is produced. Explain.

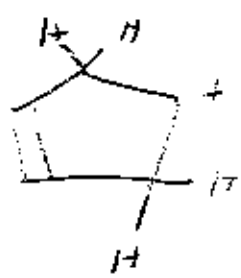


allyl carbocation = most stable cation



3-chlorocyclopentene

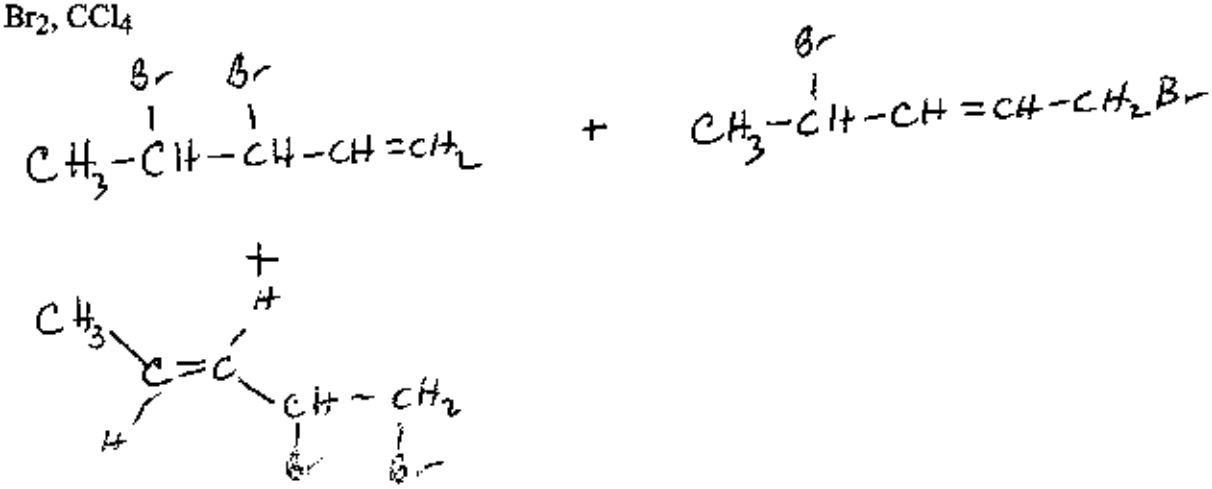
to make 4-chlorocyclopentene would require the formation of



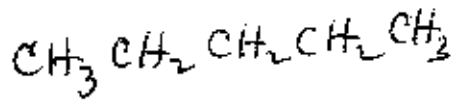
which is not as stable as the secondary allylic carbocation that lead to 3-chlorocyclopentene

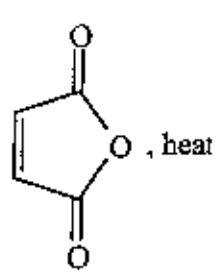
4. (*9 points*) Give the principal products expected when *trans*-1,3-pentadiene reacts under the following conditions. Assume *one equivalent* of each reagent reacts unless noted otherwise. Ignore stereochemistry.

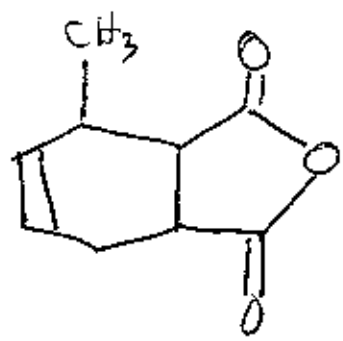
a) Br_2, CCl_4



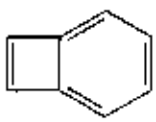
b) H_2 (2 equivalents), Pd/C



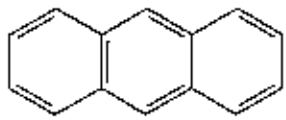
c)  , heat



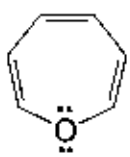
5. (*9 points*) Using the Hückel 4n+2 rule, determine whether each of the following compounds is likely to be aromatic.

a) 

8 electrons
not aromatic

b) 

14 electrons - aromatic

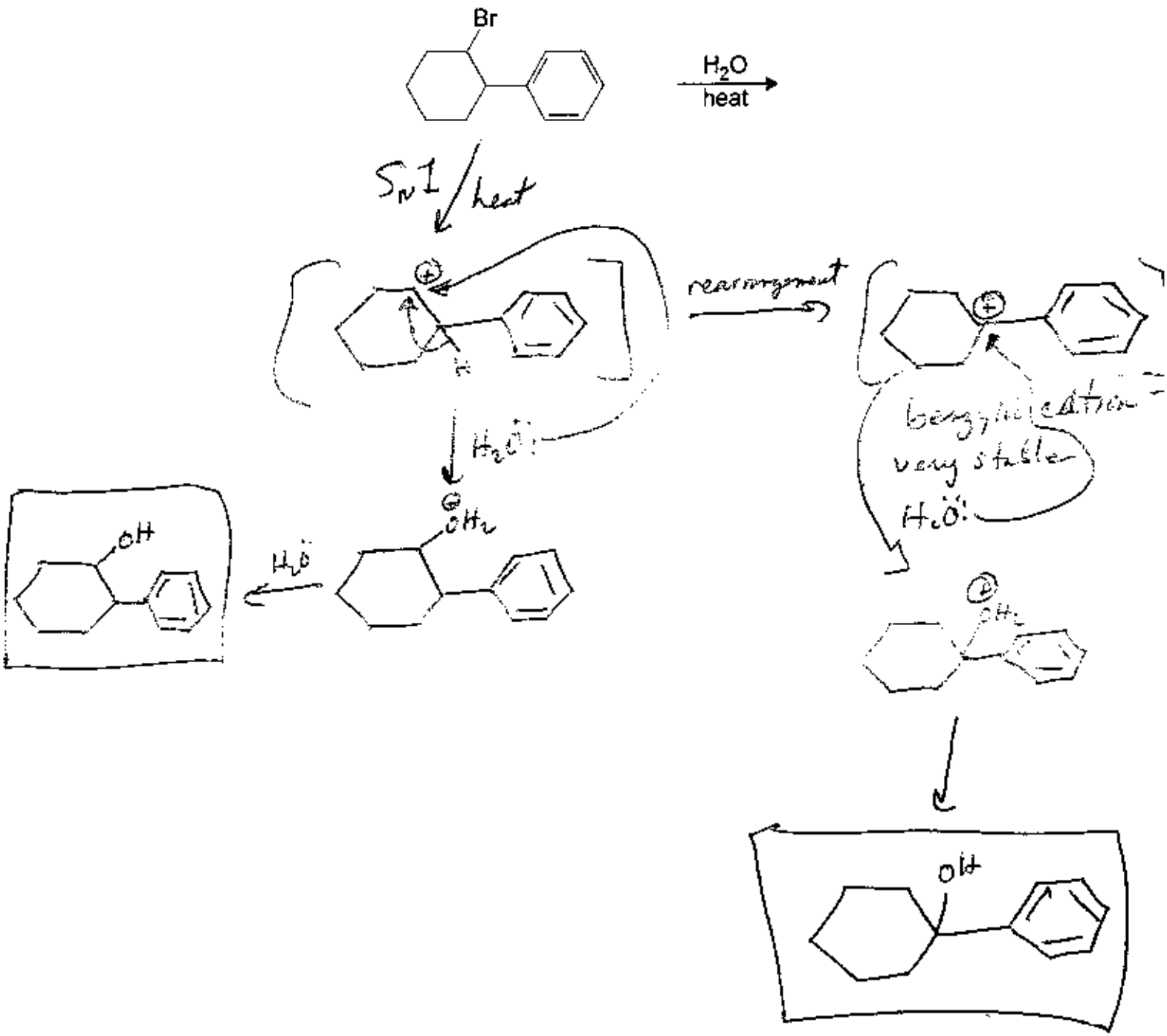
c) 

oxepin

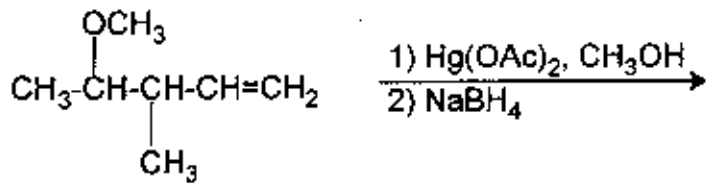
10 electrons, counting a pair of non-bonded electrons on the oxygen to maintain the continuous π-electron system needed for aromatic structures

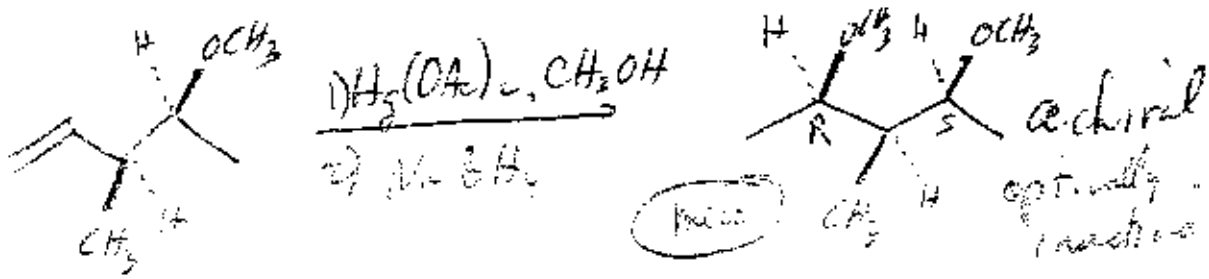
therefore, not aromatic

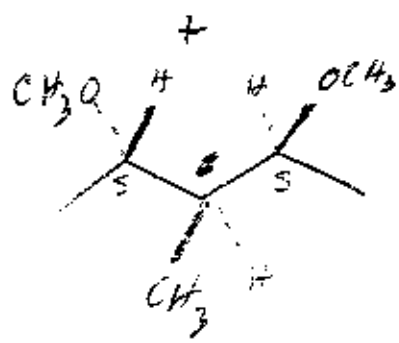
6. *(10 points)* What are the *two substitution* products of the following S_N1 reaction? One of the products is the normal S_N1 product, and the other is the product of the most reasonable rearrangement. Provide a mechanism.



7. (*15 points*) When (3*S*, 4*S*)-4-methoxy-3-methyl-1-pentene (basic structure given below without stereochemisty) is treated with $Hg(OAc)_2$ in *pure methanol* (CH_3OH), then with $NaBH_4$, two isomeric compounds with the formula $C_8H_{18}O_2$ are isolated. One, compound **A**, is optically inactive, and the other, compound **B**, is optically active. Give the structures and absolute configurations of both compounds.

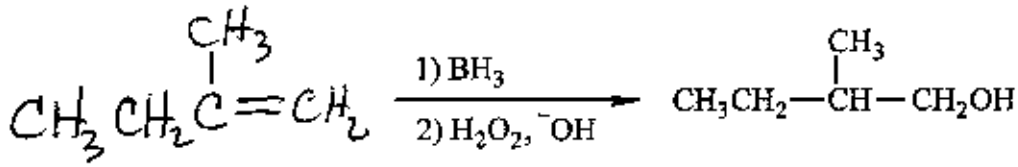


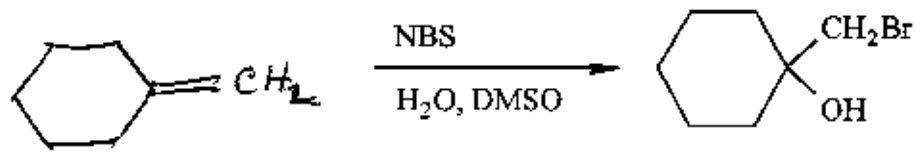


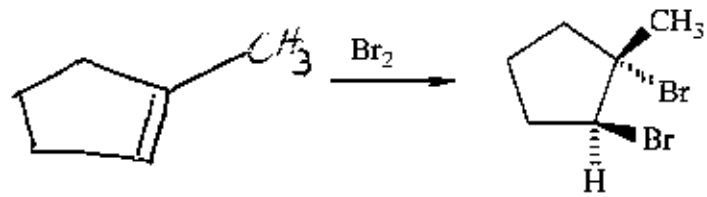


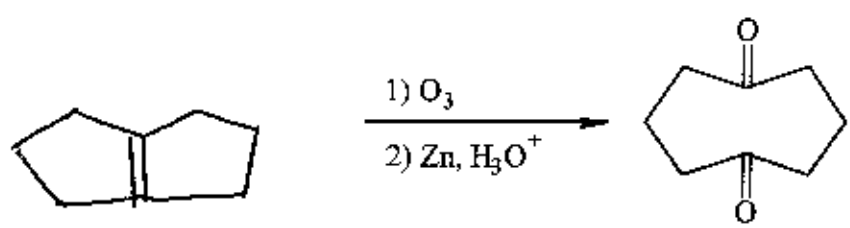
chiral -
optically active

8. (*20 points*) From which alkene could each of the following compounds be prepared?

a) 

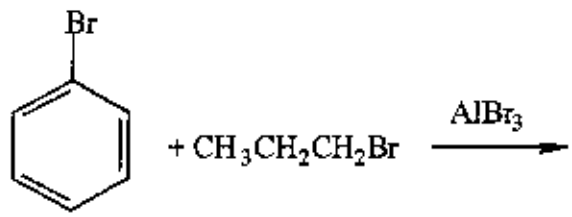
b) 

c) 

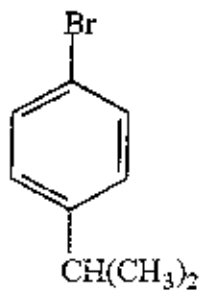
d) 

9. (*50 points*)

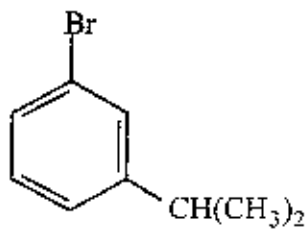
(a) The major product of the following reaction is:



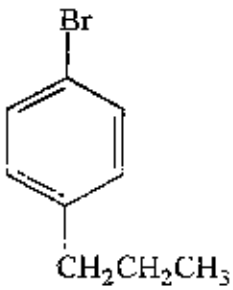
(1)



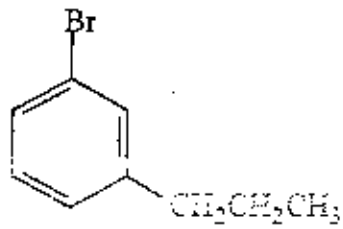
(3)



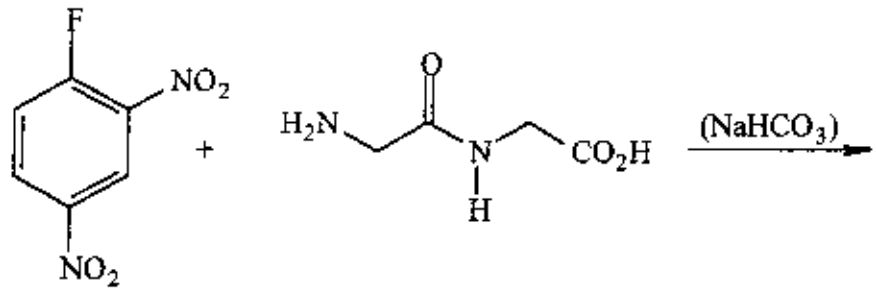
(2)



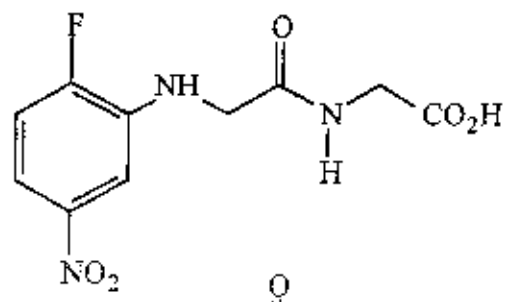
(4)



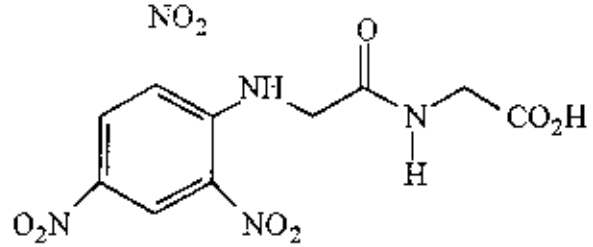
(b) Predict the product from this reaction:



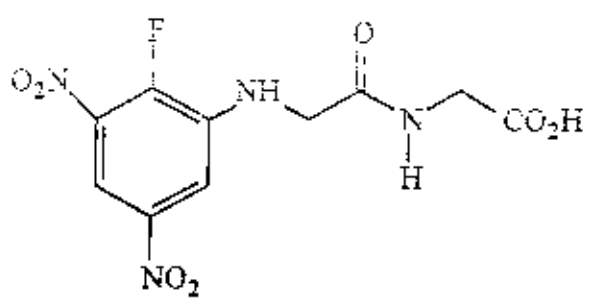
(1)



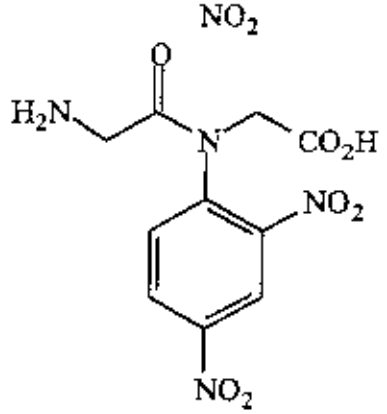
(2)



(3)



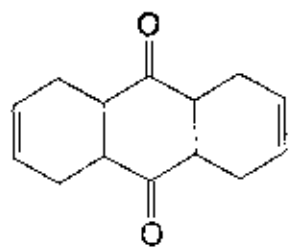
(4)

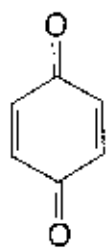


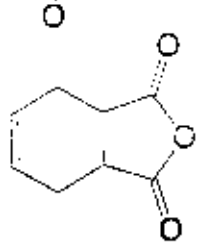
(c) The *less* stable chair conformation of *trans*-3-methyl-1-*tert*-butylcyclohexane has:

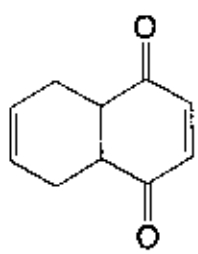
(1) an axial methyl group and an equatorial *tert*-butyl group.
(2) an axial *tert*-butyl group and an equatorial methyl group.
(3) both alkyl groups in axial positions.
(4) both alkyl groups in equatorial positions.

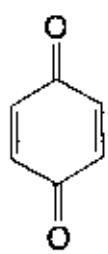
(d) The ketone below can be prepared *via* a Diels-Alder reaction with which reagents?



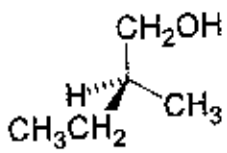
1)  , $CH_2=CH_2$

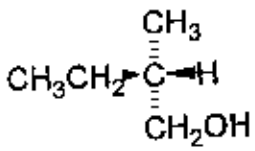
2)  , $CH_2=CH-CH=CH_2$

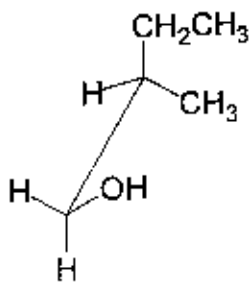
3)  , $CH_2=CH_2$

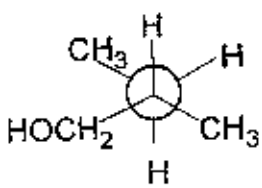
4)  , $CH_2=CH-CH=CH_2$

(e) Which of the following correspond to (*S*)-2-methyl-1-butanol?

A) 

C) 

B) 

D) 

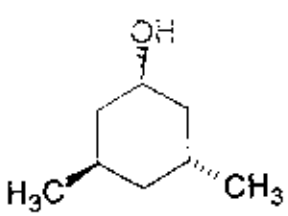
(1) A, C, D

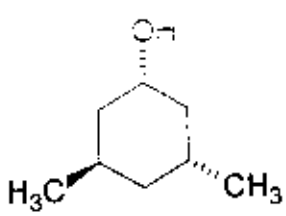
(2) A, B, C

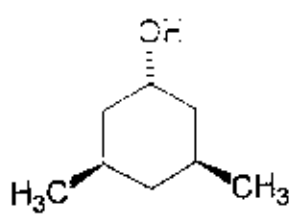
(3) C, D

(4) B, D

(f) What are the relationships between the three compounds below?


A


B


C

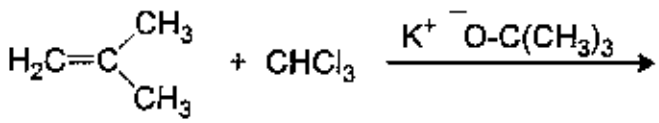
(1) *A* and *B* are diastereomers, *B* and *C* are diastereomers, and *A* and *C* are enantiomers.

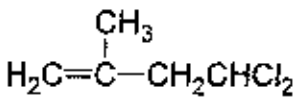
(2) *A* and *B* are identical, *B* and *C* are diastereomers, and *A* and *C* are diastereomers.

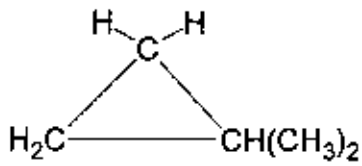
(3) *A* and *B* are enantiomers, *B* and *C* are diastereomers, and *A* and *C* are diastereomers.

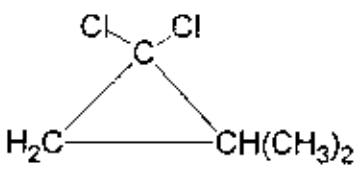
(4) *A* and *B* are identical, *B* and *C* are enantiomers, and *A* and *C* are diastereomers

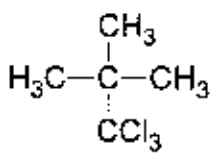
(g) What is the major product of the reaction below?



1) 

3) 

(2) 

4) 

(h) Which of the following reactions is a good way to prepare methyl *tert*-butyl ether?

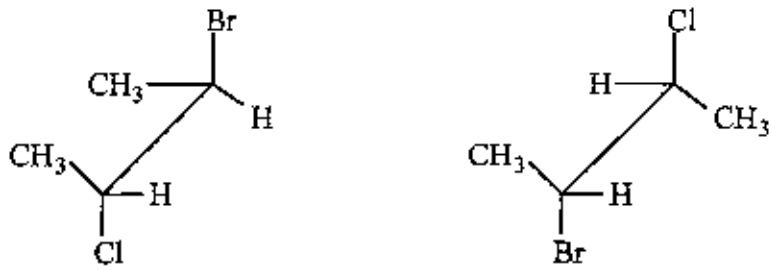
(1) $CH_3O^-\ Na^+ + (CH_3)_3CBr \longrightarrow$

(2) $(CH_3)_3CO^-\ Na^+ + CH_3I \longrightarrow$

(3) $(CH_3)_3C{-}OH + CH_3OH \xrightarrow{HO^-}$

(4) $CH_3MgBr + (CH_3)_3COCl \longrightarrow$

(i) What is the stereochemical relationship between the following molecules?



They are:

(1) identical

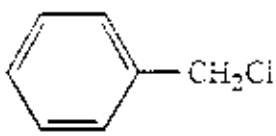
(2) enantiomers

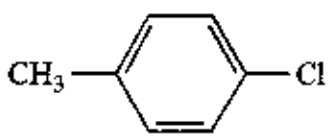
(3) conformational isomers

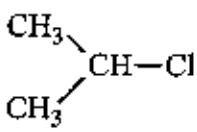
(4) diastereomers

(j) Which of the compounds shown below would react most rapidly with iodide ion in the S_N2 reaction illustrated below?

$$R-Cl + I^- \xrightarrow[\text{acetone}]{} R-I + Cl^-$$

(1) 

(2) 

(3) 

(4) $CH_3-CH=CH-Cl$