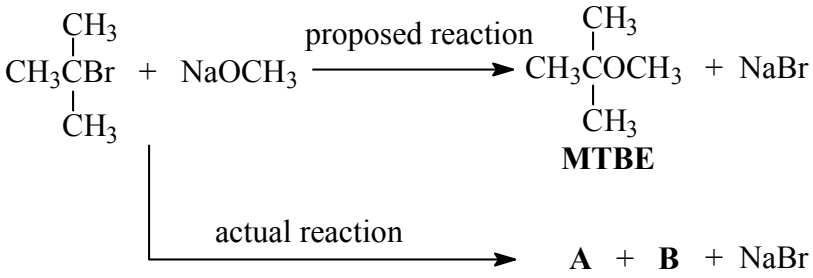
CHEM 241-601 Practice Problems for Exam II

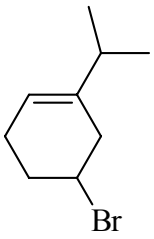
1.(10) Ethers can be easily synthesized using an S_N2 reaction between a well chosen alkyl halide and an alkoxide. However, when a young post-bac attempted to make methyl t-butyl ether (MTBE, fuel additive) using the scheme below, he failed. Instead, he isolated an unknown compound C_4H_8 (**A**) and an alcohol (**B**). Identify compounds **A** and **B**, and briefly explain why this poor student could not isolate MTBE under these conditions.



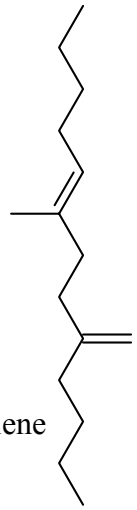
A =  B = CH_3OH

Under these conditions, an E2 reaction will occur exclusively becaus
tertiary alkyl halide (the substrate is too bulky for an SN2 reaction).

2.(8) Name the following compounds:

a) 

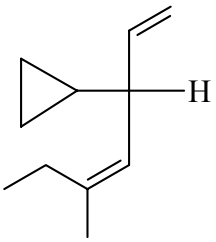
5-bromo-1-isopropylcyclohexene

b) 

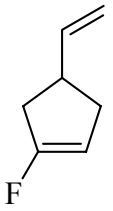
(E) 2-butyl-5-methyl-1,5-decadiene

3.(8) Draw the following compounds:

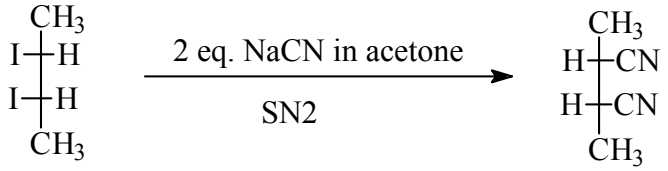
a) 5-methyl-3(R)-cyclopropyl-1,4(Z)-heptadiene

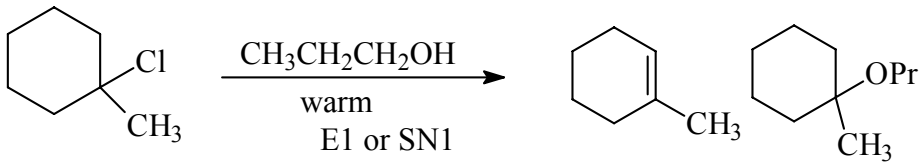


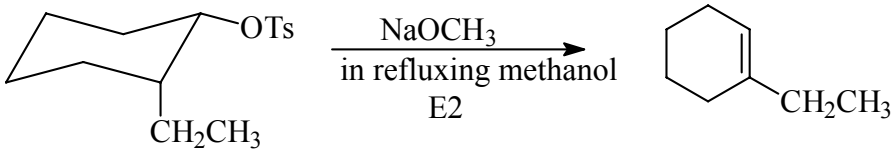
a) 1-fluoro-4-vinylcyclopentene

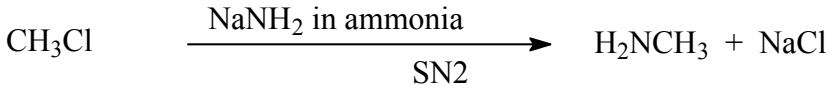


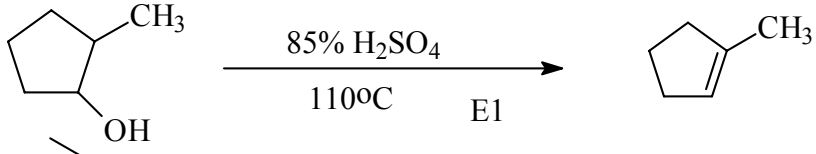
4.(45) Give the major product of the following reactions **and** indicate the mechanism (e.g. E1) through which the reaction proceeds.

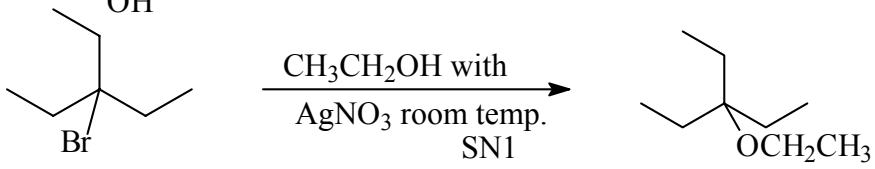
a) 

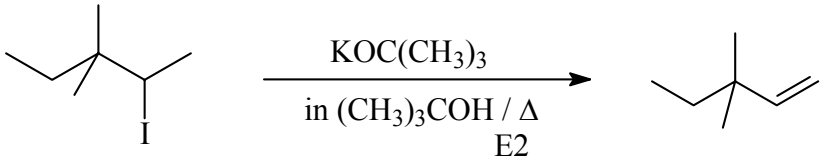
b) 

c) 

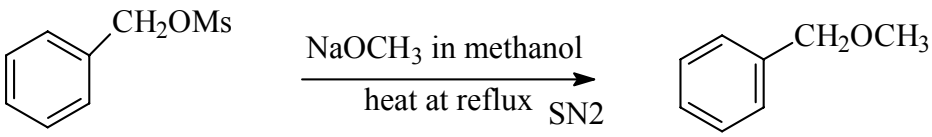
d) 

e) 

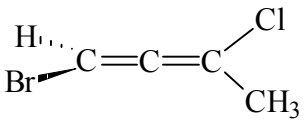
f) 

g) 

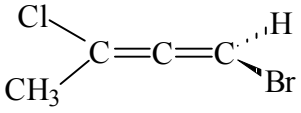
h) 

i) 

5.(10) The allene (1,2-diene) shown below has a specific rotation of –21° yet has no chiral "carbons". The molecule does, however, have a chiral "center". Briefly explain this unusual phenomenon. Is this allene (R) or (S)? Draw the stereoisomer that has an $[\alpha]_D = +21^o$.



$[\alpha]_D = -21^o$

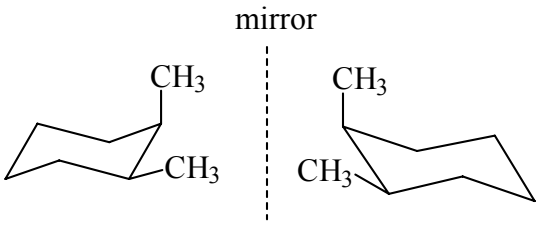


$[\alpha]_D = +21^o$

The 3 carbons taken together constitute a chiral "center". Its mirror image is non-superimposible upon itself. The allene on the left is (R)

6.(10) Give brief explanations for the following observations:

a) cis 1,2-dimethylcyclohexane is optically inactive even though it has 2 chiral centers and the mirror images do not *appear* to be superimposible.

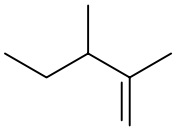


These two structures are not superimposible but if you flip one, it becomes the other (hence superimposible). The ring flip is so rapid, that it is a meso compound (a time-averaged internal plane of symmetry).

b) Addition of HBr to 1-butene yields an optically inactive product despite the formation of a chiral center.
A racemic mixture of alkyl bromides forms.

7.(15) Arrange the following in order of increasing (1 = lowest, slowest):

a) ΔH of hydrogenation:



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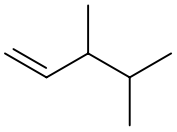

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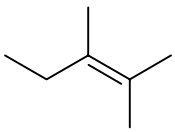
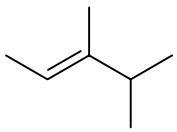
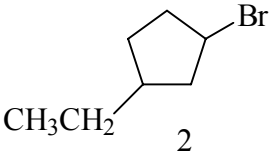


1



2

b) S_N1 reaction rate:



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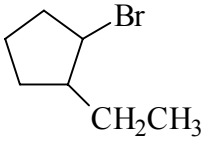
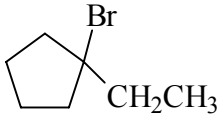


3



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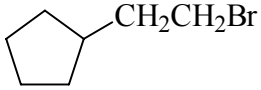


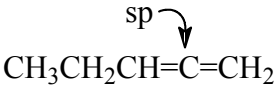
1

c) number of sites (elements) of unsaturation:

	C_5H_9Br	C_4H_7N	$C_7H_{10}O_2$	$C_9H_{14}Cl_2Br_4$
# sites	1	2	3	0
rank	2	3	4	1

8.(12)

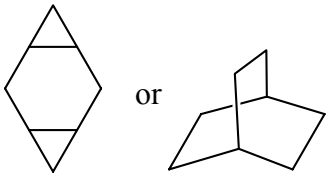
a) **Draw a compound** with a molecular formula of C_5H_8 with one sp hybridized carbon.



c) **Give the formula** of a hydrocarcbon with 8 carbons, zero π bonds and three rings.

C_8H_{12}

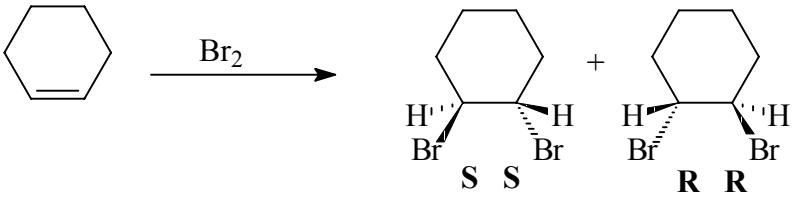
c) **Propose a structure** of compound with the characteristics described in part b).



or

many possibilities

9.(10) The bromination of cyclohexene gives the two compounds shown below. **Assign *R* or *S* to each chiral center in the products**. Are the two molecules enantiomers, diastereomers or identical? **enantiomers**



10.(8) (2R,3S)-3-phenyl-2-iodobutane undergoes E2 elimination on treatment with ethoxide ion to yield exclusively (Z)-2-phenyl-2-butene as shown below. Explain this observation using either a Newman or **sawhorse** projection of the substrate in your answer.