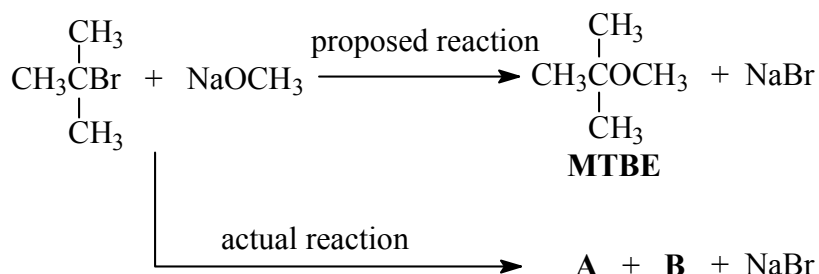
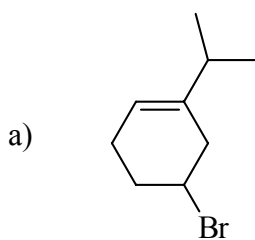


1.(10) Ethers can be easily synthesized using an S_N2 reaction between a well chosen alkyl halide and an alkoxide. However, when a young post-bac attempted to make methyl t-butyl ether (MTBE, fuel additive) using the scheme below, he failed. Instead, he isolated an unknown compound C_4H_8 (**A**) and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

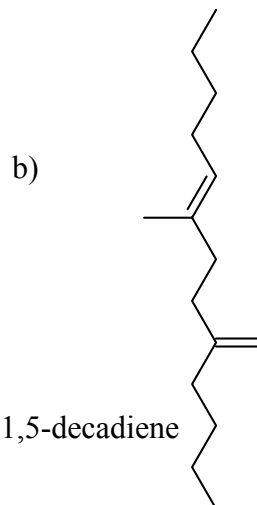


Under these conditions, an E2 reaction will occur exclusively because tertiary alkyl halide (the substrate is too bulky for an S_N2 reaction).

2.(8) Name the following compounds:



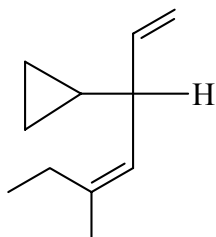
5-bromo-1-isopropylcyclohexene



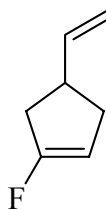
(E) 2-butyl-5-methyl-1,5-decadiene

3.(8) Draw the following compounds:

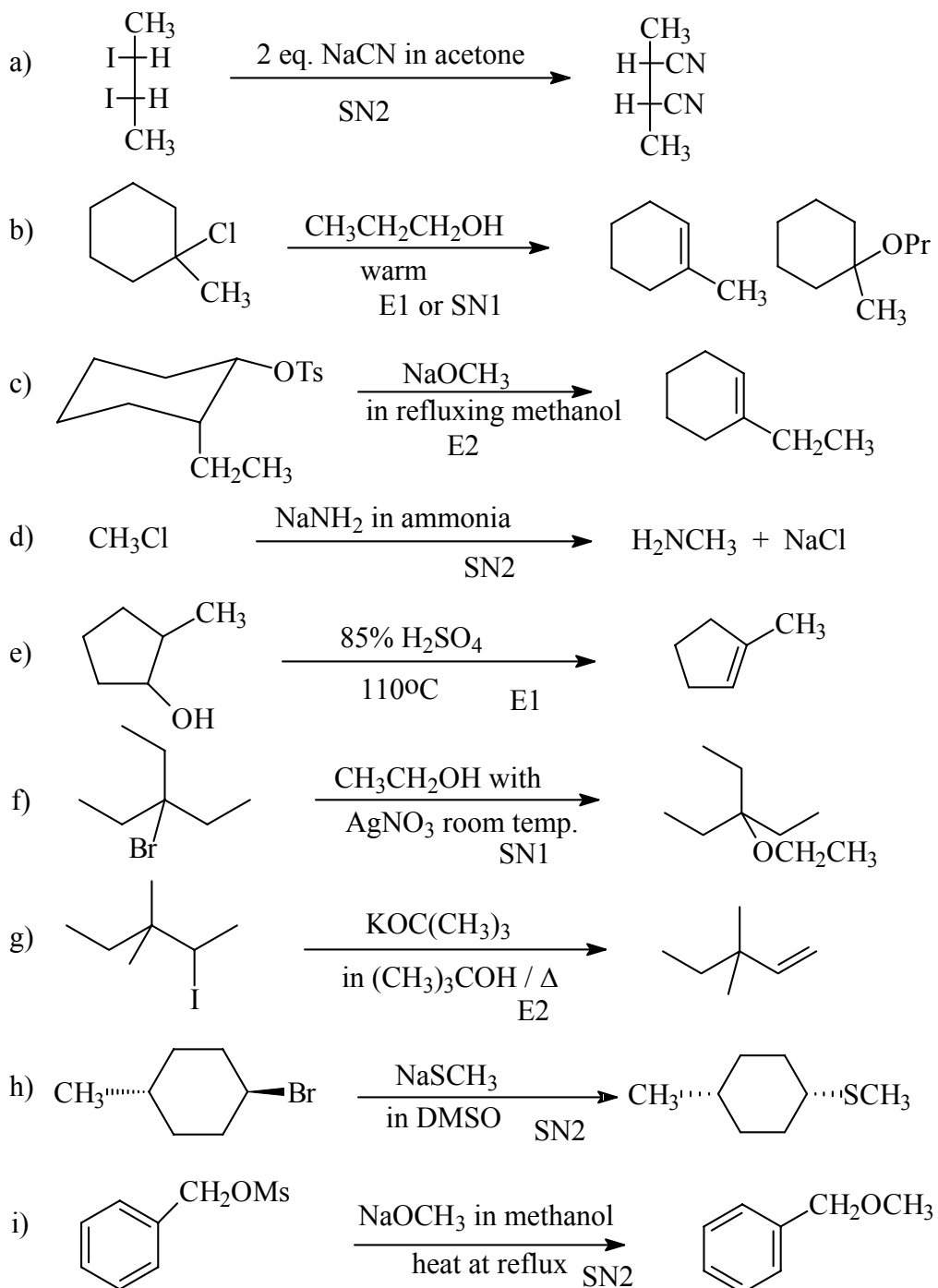
a) 5-methyl-3(R)-cyclopropyl-1,4(Z)-heptadiene



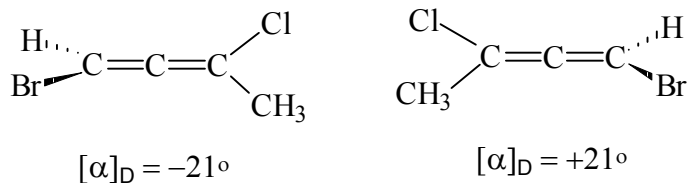
a) 1-fluoro-4-vinylcyclopentene



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



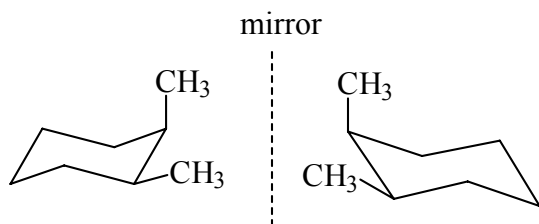
5.(10) The allene (1,2-diene) shown below has a specific rotation of -21° yet has no chiral “carbons”. The molecule does, however, have a chiral “center”. Briefly explain this unusual phenomenon. Is this allene (R) or (S)? Draw the stereoisomer that has an $[\alpha]_D = +21^\circ$.



The 3 carbons taken together constitute a chiral “center”. Its mirror image is non-superimposable 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 superimposable.

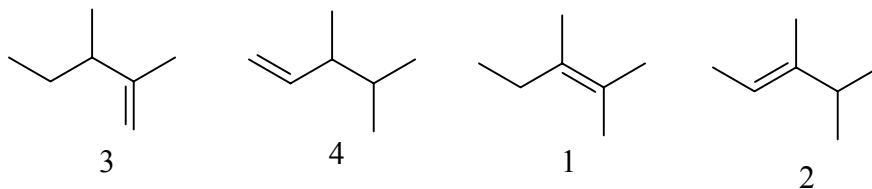


These two structures are not superimposable but if you flip one, it becomes the other (hence superimposable). The ring flip is so rapid, that it is a meso compound (a time-averaged internal plane of symmetry).

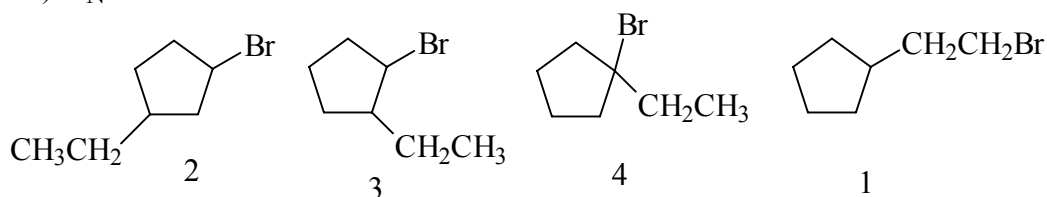
- b) Addition of HBr to 1-butene yields an optically inactive product despite the formation of a chiral center.
A racemic mixture of alkyl bromides forms.

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

a) ΔH of hydrogenation:



b) S_N1 reaction rate:

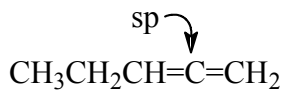


c) number of sites (elements) of unsaturation:

	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)

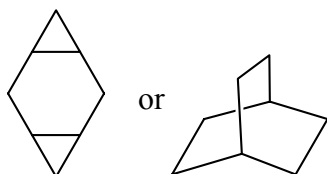
a) **Draw a compound** with a molecular formula of C_5H_8 with one sp hybridized carbon.



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

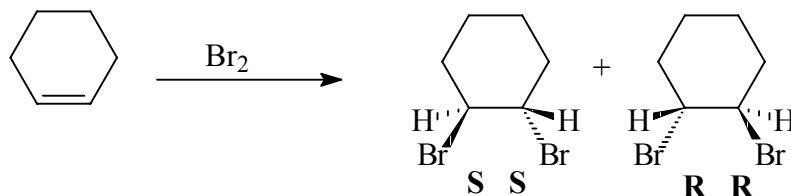


c) **Propose a structure** of compound with the characteristics described in part b).



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) (2*R*,3*S*)-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.

