

My name is: \_\_\_\_\_

### Periodic Table

H																			He
Li	Be											B	C	N	O	F		Ne	
Na	Mg											Al	Si	P	S	Cl		Ar	
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br		Kr	
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I		Xe	
Cs	Ba	La	Ha	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At		Rn	
Fr	Ra	Ac																	

Please sit with an empty seat between you and your neighbors.

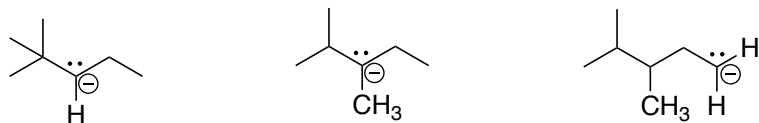
For full credit, any explanations you write should **be complete and grammatically-correct sentences**.

Feel free to ask questions about the questions, but **please don't ask questions about your answers**; I won't answer them and it distracts your neighbors.

	Possible	Earned
Page 2	16	_____
Page 3	26	_____
Page 4	24	_____
Page 5	18	_____
Page 6	16	_____
Total	100	_____

1 Provide the MO diagram for the  $\pi$ -system of butadiene and label the HOMO and LUMO. Note that I'm looking for the picture of the atomic orbitals including their phase and with a clear indication of the presence of any nodes (8 pts).

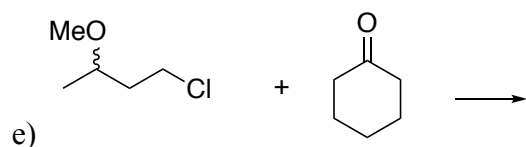
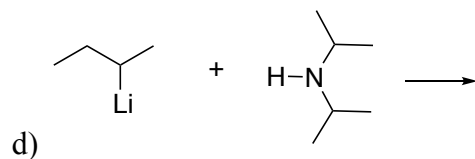
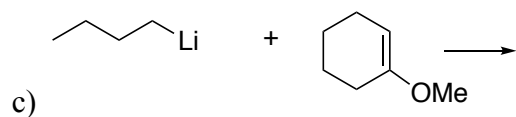
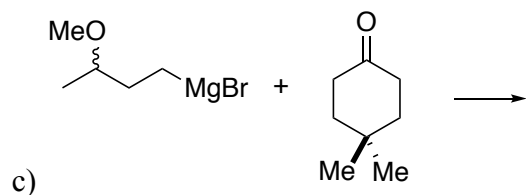
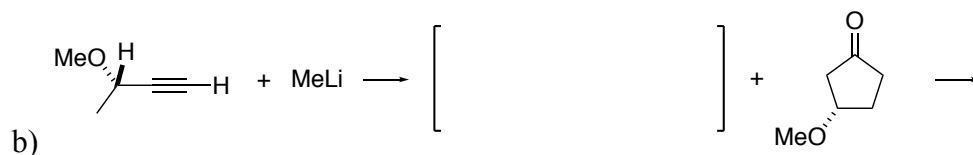
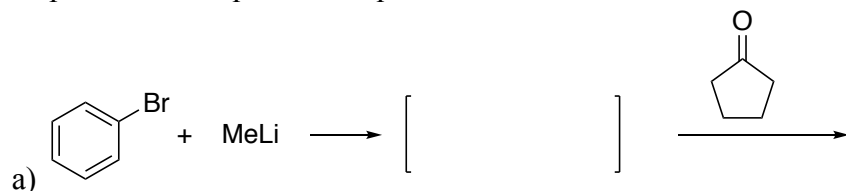
2) Rank the molecules shown below in increasing stability (most stable = 1 least stable = 3) 4 pts.



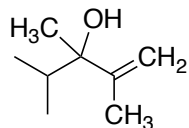
3) Does the molecule shown below enjoy hyperconjugative stabilization? Explain your answer by drawing the orbitals and explain why they do, or do not, lead to hyperconjugative stabilization in a single, grammatically correct sentence. 4 pts



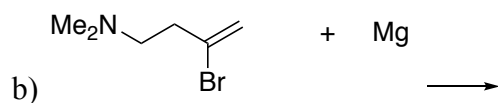
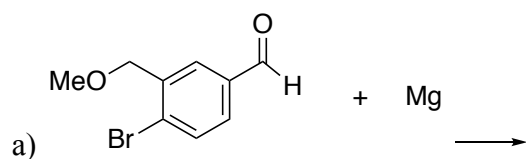
4) Provide the products of the following reactions (all chiral starting materials are racemic mixture and all reactions have an appropriate aqueous work up). If no reaction would occur, write NR. If a reaction would produce stereoisomers, draw the isomers and indicate if they will be produced in equal or unequal amounts.



5) Provide all C-C bond cleaving retrosynthetic disconnections for the molecule shown below (12 points).



6) A feckless chemist, T. Erik, attempts to form Grignard reagents from the bromides shown below. He suspects that some of these will provide the desired Grignard while others will not. **Provide the Grignard for those that will proceed without problems and for those that will be problematic, indicate what the problem will be in a single sentence.** (6 pts)



7) Provide definitions for the terms provided below in one sentence. (6 pts).

a) Stereoisomer

b) Meso

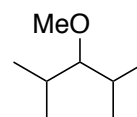
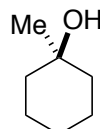
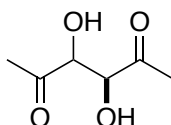
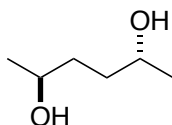
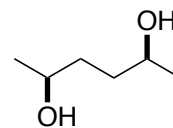
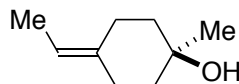
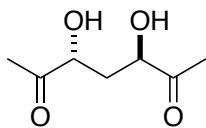
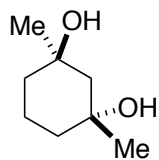
c) Racemic

8) For the molecules shown below: (12 pts total)

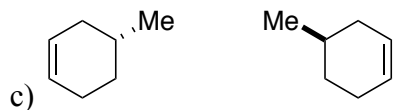
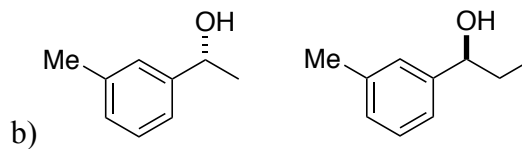
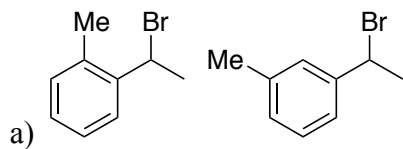
a) Indicate if they are chiral, achiral, or if there is not enough information to determine.

b) For achiral molecules, indicate if the molecules are also "meso".

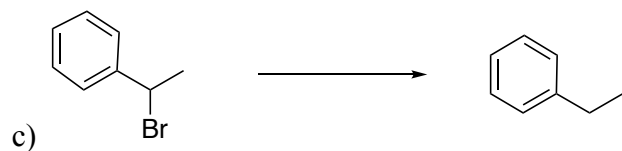
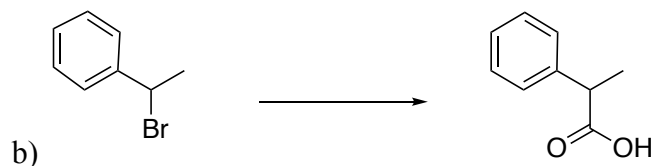
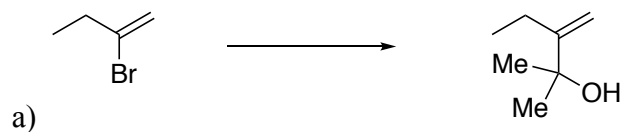
c) For achiral molecules, indicate the position of the mirror plane.



9) Are the pairs of molecules shown below Constitutional isomers (C), Enantiomers (E), Diastereomers (D), Identical (I), or not isomers (N)? (6 pts)



10) Complete the syntheses shown below using the starting material indicated and any reagent containing 6 or fewer carbons. If your synthesis contains intermediates, please draw the intermediates for full credit. (12 pts)



11) Provide the pka of: (4pts)

acetylene:

ammonia: