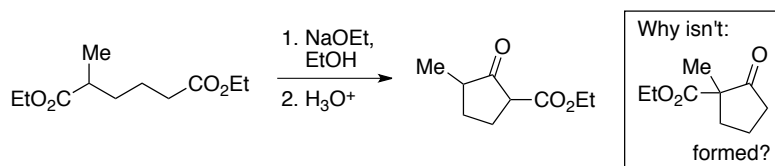
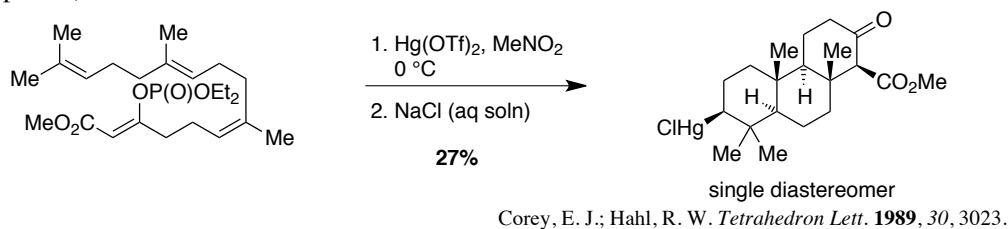


Provide a mechanism for each of the reactions below. Make sure that your answer provides an explanation for the observed stereochemical outcome of the reaction.

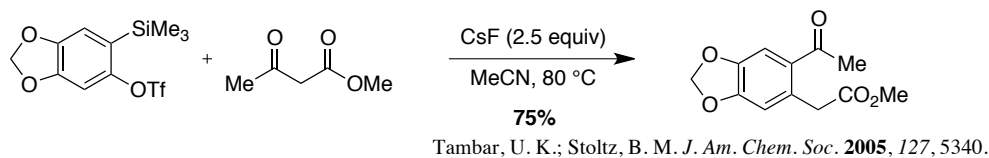
1. (a) (10 points)



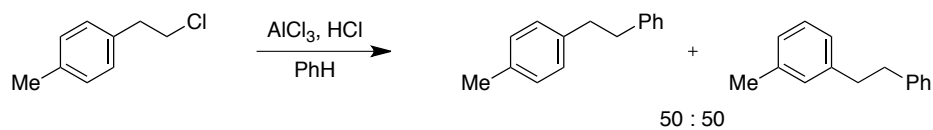
(b) (10 points)



(c) (10 points)



(d) (10 points)

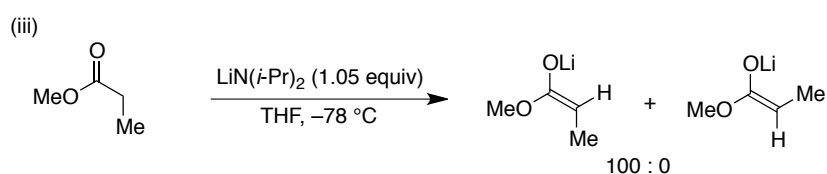
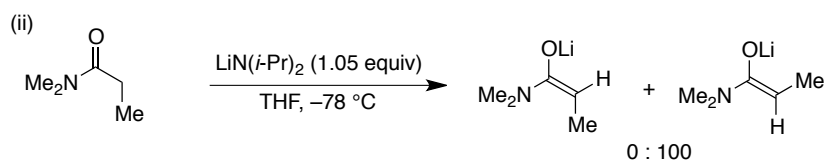
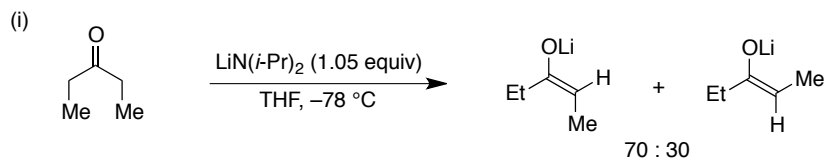


(a) Cram, D. J. *J. Am. Chem. Soc.* **1964**, 86, 3767.

(b) Olah, G. A.; Head, N. J.; Rasul, G.; Prakash, G. K. S. *J. Am. Chem. Soc.* **1995**, 117, 875.

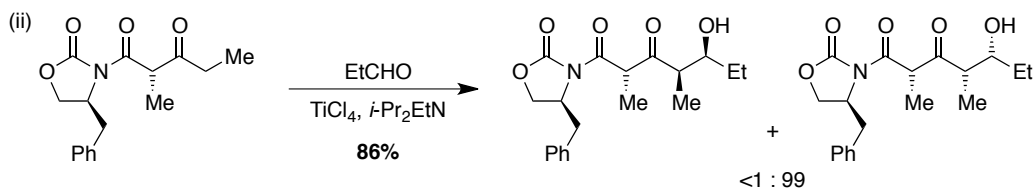
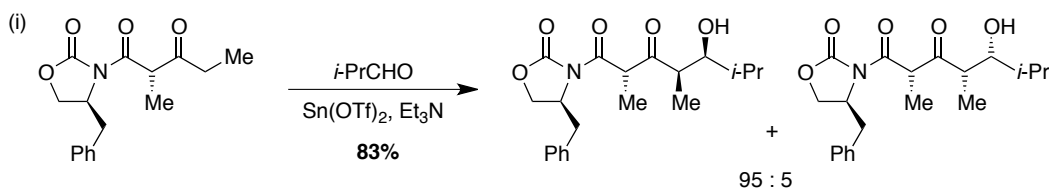
2. Provide an explanation to rationalize the stereochemical outcome of each of the following reactions.

(a) (15 points)



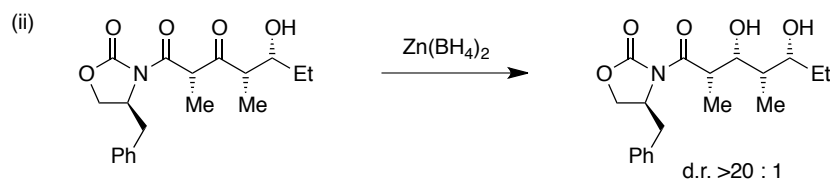
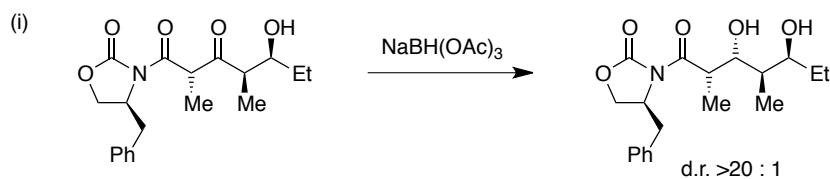
Ireland, R. E.; Wipf, P.; Armstrong, J. D. III. *J. Org. Chem.* **1991**, *56*, 650.

(b) (10 points)



Evans, D. A.; Clark, J. S.; Metternich, R.; Novack, V. J.; Sheppard, G. S. *J. Am. Chem. Soc.* **1990**, *112*, 866.

(c) (10 points)



Evans, D. A.; Clark, J. S.; Metternich, R.; Novack, V. J.; Sheppard, G. S. *J. Am. Chem. Soc.* **1990**, *112*, 866.

3. (10 points) Draw a complete molecular orbital diagram for  $\text{:C}\equiv\text{N-H}$ . Draw what each orbital looks like and identify both the HOMO and LUMO.

4. (15 points) Match the correct response with the statement below.

_____ Bond angle for tetrahedral carbon	(a) -17
_____ methoxy-cyclohexane A-value ( $\text{kcal}\cdot\text{mol}^{-1}$ )	(b) 145
_____ gauche butane interaction	(c) 120
_____ Strength of C-C bond ( $\text{kcal}\cdot\text{mol}^{-1}$ )	(d) 3
_____ $E_{\text{rel}}$ of twist cyclohexane conformation ( $\text{kcal}\cdot\text{mol}^{-1}$ )	(e) 0.8
_____ $\Delta H^\circ$ for Diel-Alder reaction ( $\text{kcal}\cdot\text{mol}^{-1}$ )	(f) 109.5
_____ $\Delta G^\circ$ for $K_{\text{eq}} = 10$ ( $\text{kcal}\cdot\text{mol}^{-1}$ )	(g) 0.6
_____ $\Delta G^\circ$ for trans- to cis-butadiene conformation change ( $\text{kcal}\cdot\text{mol}^{-1}$ )	(h) 5.5
_____ pKa of EtO-H	(i) 5
_____ methyl-cyclohexane A-value ( $\text{kcal}\cdot\text{mol}^{-1}$ )	(j) 12
_____ Strength of C-H bond ( $\text{kcal}\cdot\text{mol}^{-1}$ )	(k) 18
_____ Ring strain of cyclopropane ( $\text{kcal}\cdot\text{mol}^{-1}$ )	(l) 1.8
_____ Symmetry of the HOMO of methane ( $\text{CH}_4$ )	(m) $\sigma$
_____ $\Delta G^\ddagger$ for ethane rotation ( $\text{kcal}\cdot\text{mol}^{-1}$ )	(n) $\pi$
_____ maximum $\Delta G^\ddagger$ for <i>n</i> -butane rotation ( $\text{kcal}\cdot\text{mol}^{-1}$ )	(o) 42
	(p) 27
	(q) 1.4
	(r) 81
	(s) 104
	(t) 6
	(u) 0.9