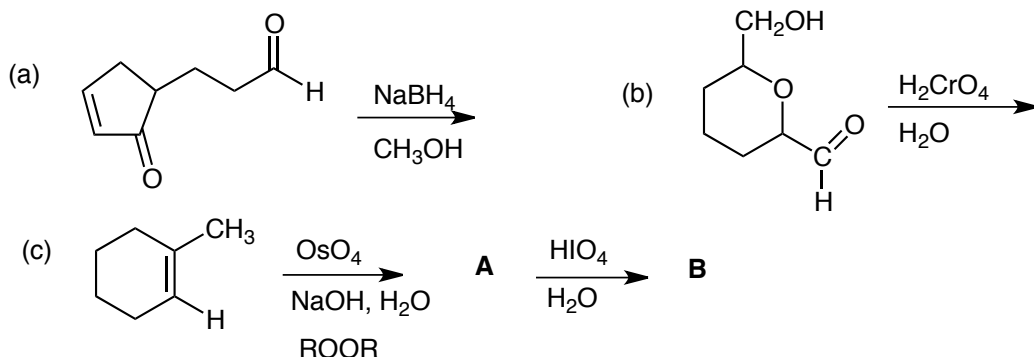
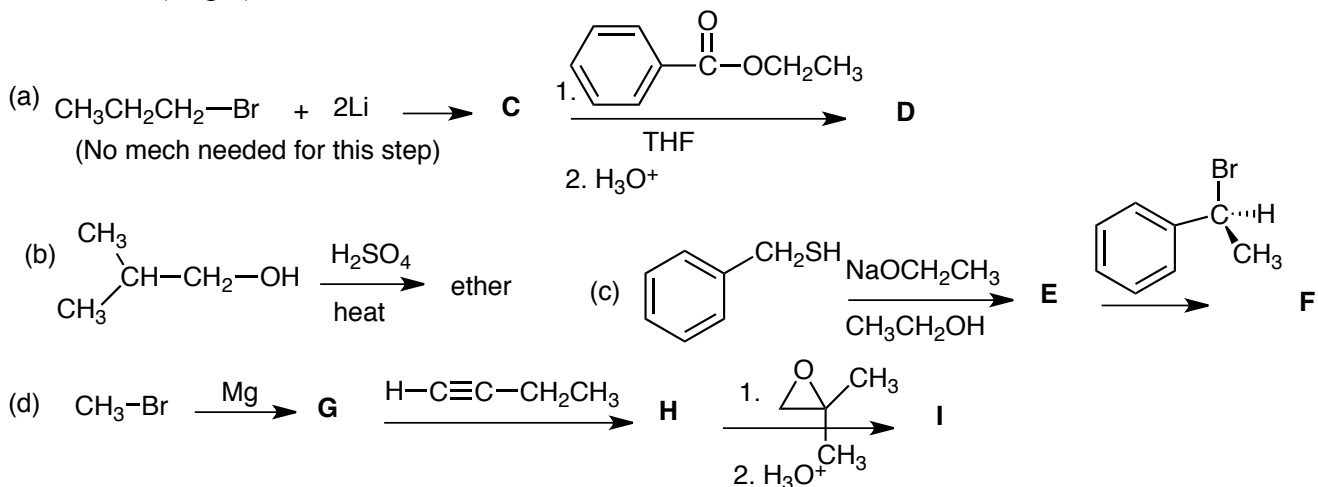


1. Identify the following molecules: (a) formula ( $C_4H_8O_2$ ). IR:  $1745\text{ cm}^{-1}$ ;  $^1\text{H NMR}$ :  $\delta$  1.1, triplet, 3H; 2.1, singlet, 3H; 3.8, quartet, 2H. (b) formula ( $C_{12}H_{15}O_2$ ). IR:  $3200 - 3500$  and  $1723\text{ cm}^{-1}$ .  $^1\text{H NMR}$ :  $\delta$ ; 1.0, doublet, 6H; 2.1, septet, 1H; 2.2, triplet, 2H; 2.4, triplet, 2H; 7.2, doublet, 2H; 7.4, doublet, 2H. (20 pts)

2. Give the product of the following reactions. It is not necessary to show the full mechanism. Be sure to show the stereochemistry where appropriate. (20 pts)



3. For the following reactions, give the product(s) and the complete reaction mechanisms by which they are formed. (40 pts)



4. Synthesize **two** of the following three molecules as shown. For extra credit do all three. (20 pts)

