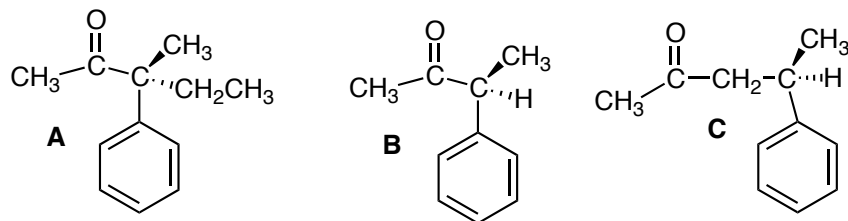
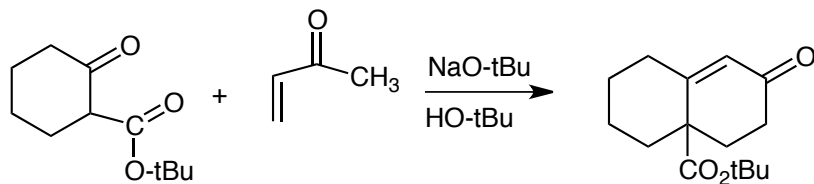


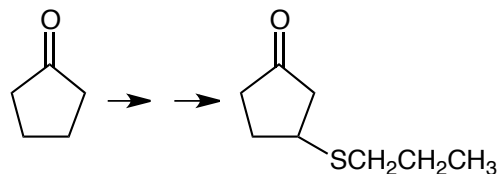
1. One of the following molecules can undergo racemization and the other two cannot. Choose this molecule, briefly justify your choice and show the reaction that occurs in acidic conditions for the molecule you choose. (10 pts)



2. Show how the following transformation occurs, showing all of the steps. (10 pts)



3. Synthesize the following molecule from the starting material given on the left. (10 pts)



3. In the preparation of methyl orange from sulfanilic acid ($\text{HOSO}_2\text{C}_6\text{H}_4\text{NH}_2$) and *N,N*-dimethylaniline [$(\text{CH}_3)_2\text{NC}_6\text{H}_5$] in the presence of sodium nitrite (NaNO_2), hydrochloric acid, sodium carbonate (Na_2CO_3) and sodium hydroxide (a) show the reaction that occurs between sulfanilic acid and sodium carbonate and briefly explain the purpose of this step. (b) How many mL of a 2.0 M solution of sodium carbonate would be needed to deliver 0.04 moles of sodium carbonate? (c) What is the purpose of adding the sodium nitrite and HCl to the sulfanilic acid solution? (d) Show the reaction that occurs between the *N,N*-dimethylaniline and acetic acid ($\text{CH}_3\text{CO}_2\text{H}$) and explain the purpose of mixing these two reagents together. (e) In the final step, after adding the sodium hydroxide solution, the reaction mixture was heated to boiling until the solution became clear. What was the purpose of doing this? (15 pts)

4. In the preparation of p-iodonitrobenzene from *p*-nitroaniline and sodium nitrite and potassium iodide (a) show the overall reaction, showing all intermediates, though you do not need to write a detailed mechanism. (b) A lot of foaming occurred when the diazonium salt was added to the potassium iodide solution. What was the cause of this foaming? Explain briefly. (5 pts)