

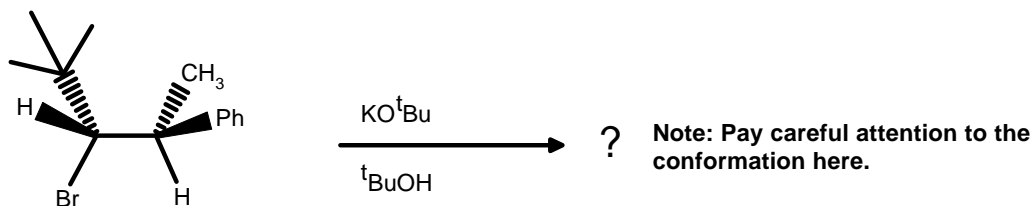
University of Windsor
Department of Chemistry and Biochemistry

Chemistry 59-235
Final Exam

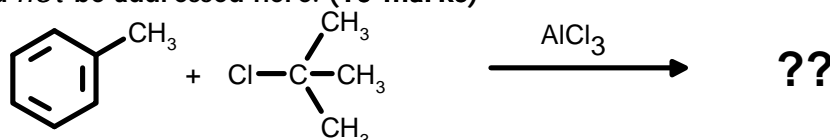
Apr. 13, 1998
Time: 3 hours

Answer all questions in the exam booklet(s) provided. Use the following values for molecular weights: C, 12.011; H, 1.008; Br, 79.904; Cl, 35.453; O, 15.999; N, 14.007.

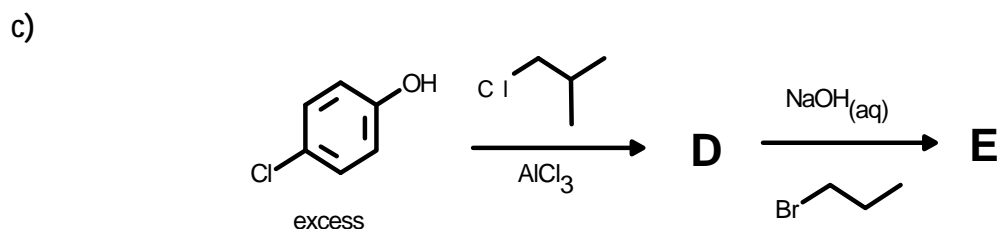
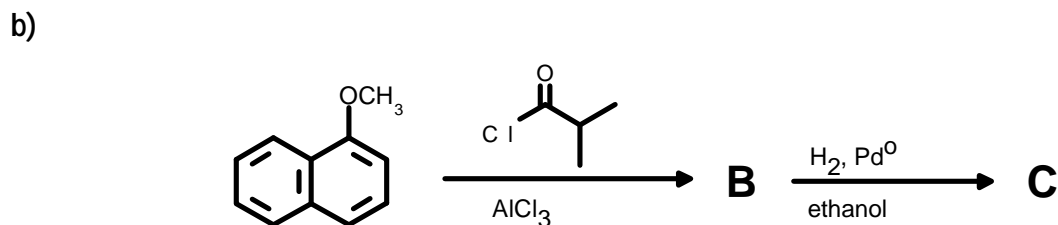
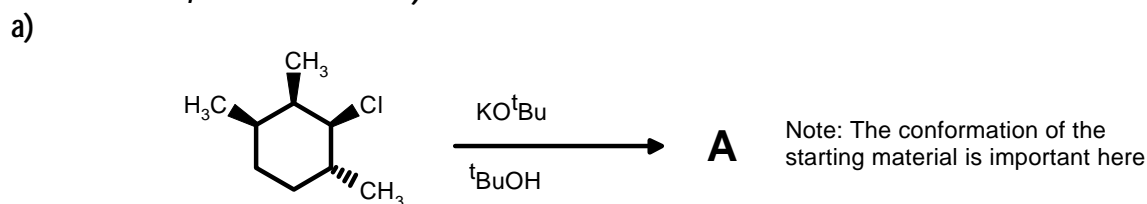
1. Show the transition state for the following reaction, including the relative orientation of the relevant groups. The complete answer will include the correct product, including the stereochemistry. (10 marks)



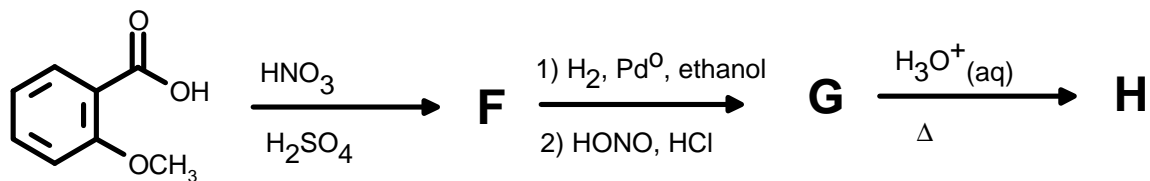
2. Give the complete mechanism for the Friedel-Crafts alkylation of toluene by *t*-butyl chloride. The complete answer will show by mechanism the reasons for the observed regiochemistry (major & minor). The normal side products of this reaction, however, need *not* be addressed here. (10 marks)



3. Predict the major products of the following transformations. Mechanisms are not necessary, but showing your work may be useful. If there's a major and minor product, show them both and take the major one on to any subsequent step.. (5 marks each letter, 50 marks total)



d)



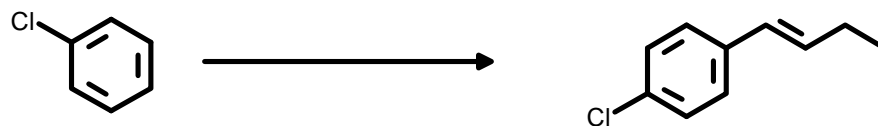
Note: Carboxylic acids are **not** easily reduced by catalytic hydrogenation

e)

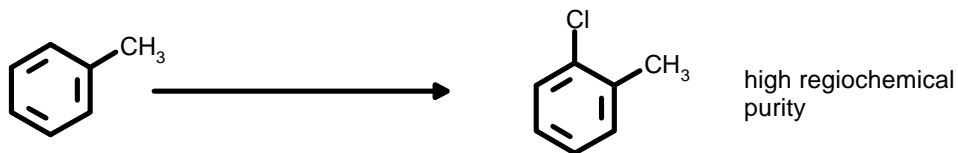


4. Show by equation (in one or several steps) how you could prepare the products illustrated below from the given starting materials. You may use any other reagents you deem fit. Show all reagents, conditions, and isolable intermediates. Mechanisms are not necessary, but showing your work may be a help. Do any four (40 marks).

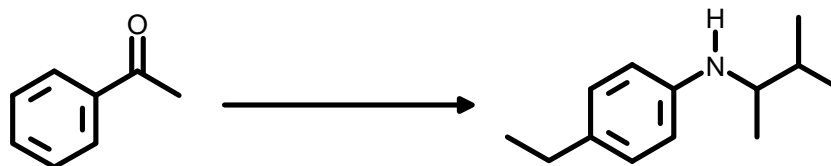
a)



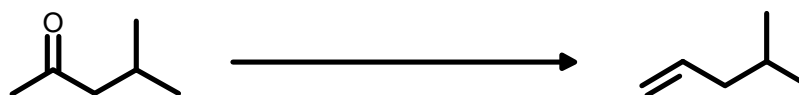
b)



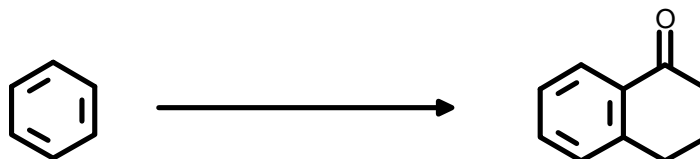
c)



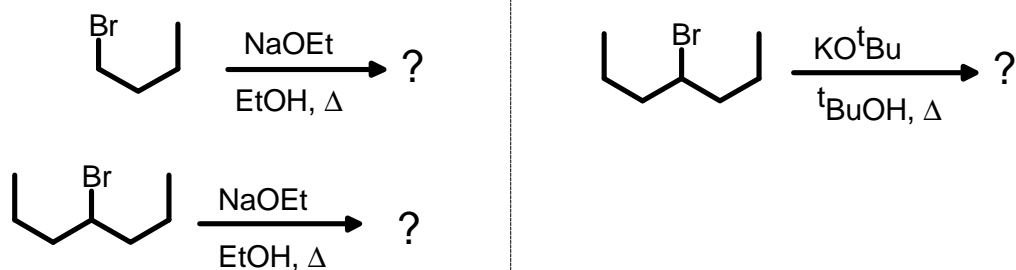
d)



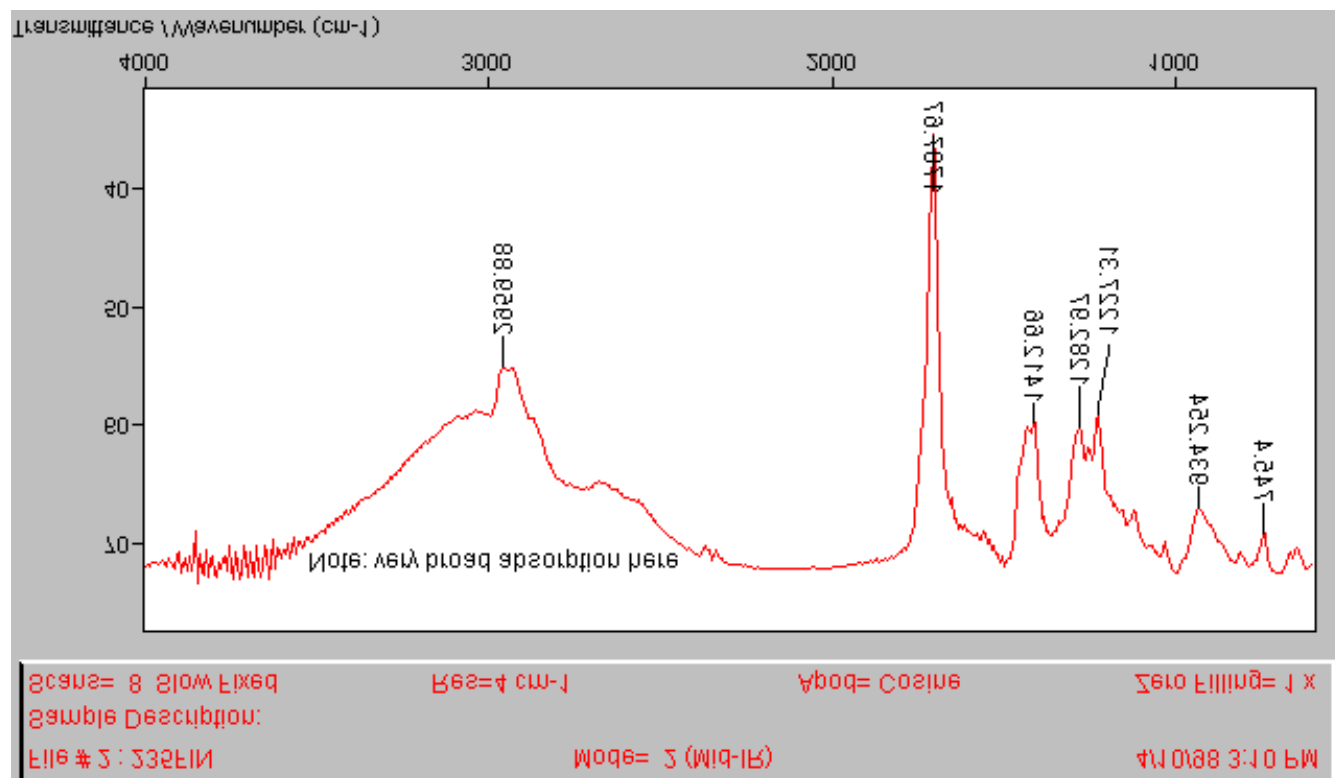
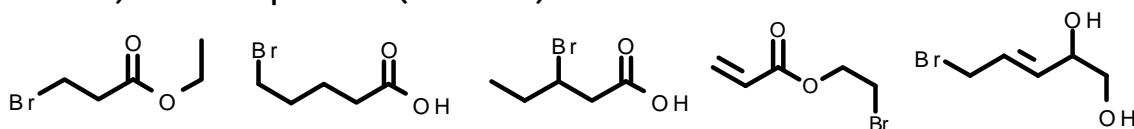
e)

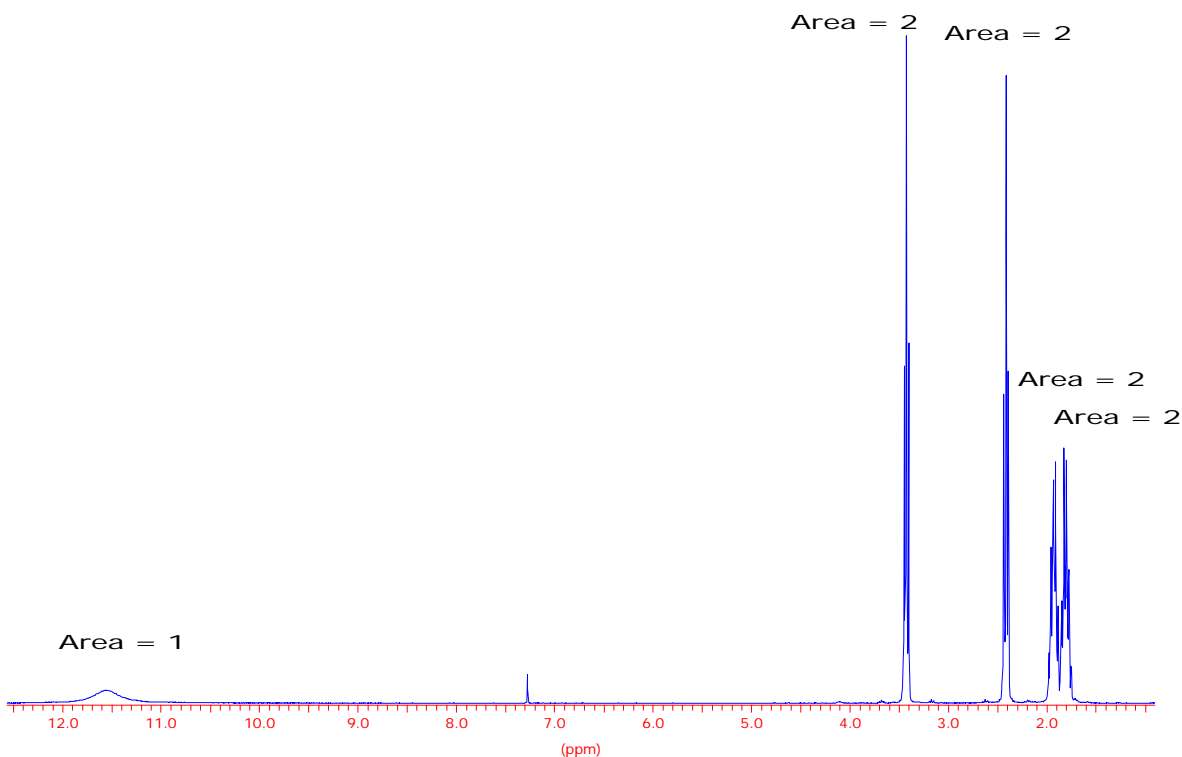


5. Rank the following reactions in their relative ability to undergo an E2 elimination as opposed to an S_N2 substitution. Include the reasons for your ordering *and* the product structures (10 marks).



6. The following compound has been analyzed, revealing a composition of C, 33.17%, H, 5.01%, Br, 44.14%, O, 17.68%. The IR (infrared) and ¹H NMR spectra are also included below. Which of the following structures is the most reasonable candidate for the compound in question, and why? Assign the ¹H NMR spectrum, showing the comparison of your calculated chemical shifts with the observed ones. Your answer should also include the assignment of the most important features (i.e., the starred ones) of the IR spectrum. (15 marks)





Bonus:

A student who had not thought carefully about some of the consequences of electrophilic aromatic substitution tried to accomplish a Friedel-Crafts acylation of the existing substrate. Instead of getting the intended quinone, he obtained a rearranged diaryl ketone as the only new compound. How did this occur? Aside: this reaction has a name; it is called the Hayashi rearrangement.

