



Chem 342 • Organic Chemistry II

Final Exam • 13 May 2009

KEY



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Please read through each question carefully and answer in the spaces provided.

A good strategy is to go through the test and answer all the questions you can do easily. Then go back and tackle the more difficult problems.

Please make sure your structures are drawn clearly and indicate any stereochemistry with bold or dashed bonds.

Finally, think about what you know. Reason and common sense can often help you out.

Problem 1 8 pts _____

Problem 2 8 pts _____

Problem 3 8 pts _____

Problem 4 10 pts _____

Problem 5 10 pts _____

Problem 6 10 pts _____

Problem 7 18 pts _____

Problem 8 18 pts _____

Problem 9 10 pts _____

Problem 10 12 pts _____

Problem 11 18 pts _____

Problem 12 18 pts _____

Problem 13 21 pts _____

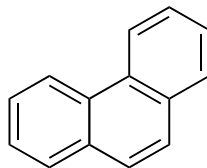
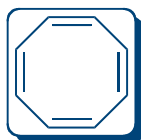
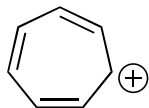
Problem 14 18 pts _____

Problem 15 13 pts _____

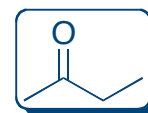
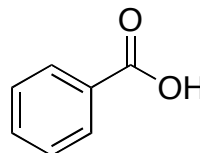
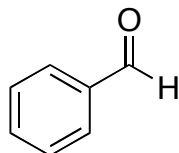
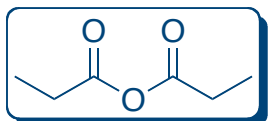
BONUS 10 pts _____

TOTAL 200 pts _____

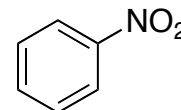
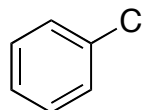
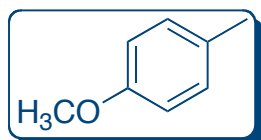
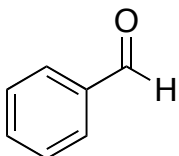
1. Circle all of the compounds below that are NOT aromatic. (8 pts)



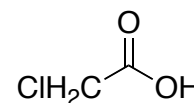
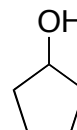
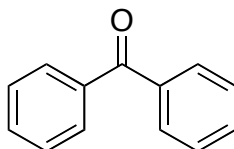
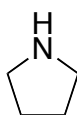
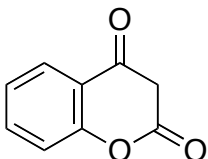
2. Circle all of the following compounds that will give a tertiary alcohol product upon reaction with excess phenyl magnesium bromide (a Grignard reagent). (8 pts)



3. Circle all of the following compounds that will undergo electrophilic aromatic substitution faster than benzene. (8 pts)



4. Rank the following compounds in order of decreasing acidity with 1 being the most acidic and 5 being the least acidic. (10 pts)



2

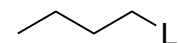
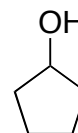
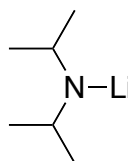
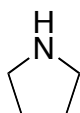
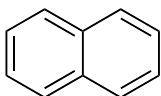
4

5

3

1

5. Rank the following compounds in order of decreasing basicity with 1 being the most basic and 5 being the least basic. (10 pts)



5

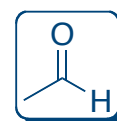
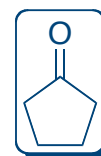
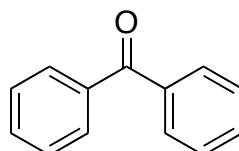
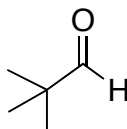
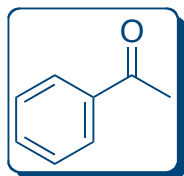
3

2

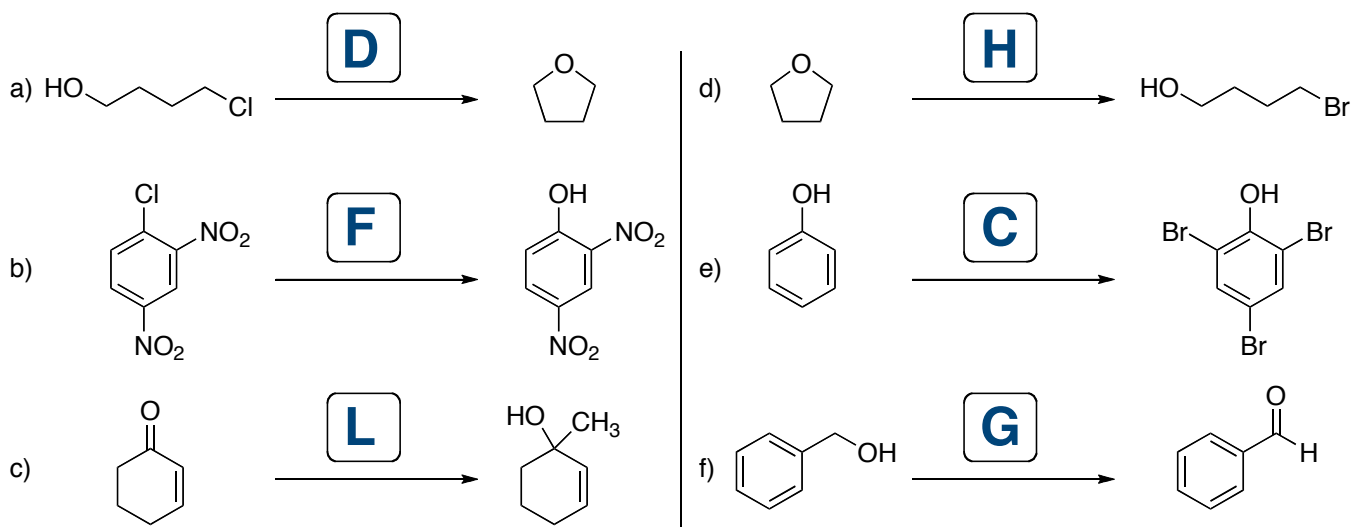
4

1

6. Circle all of the following compounds that can undergo a self aldol condensation reactions. (10 pts)



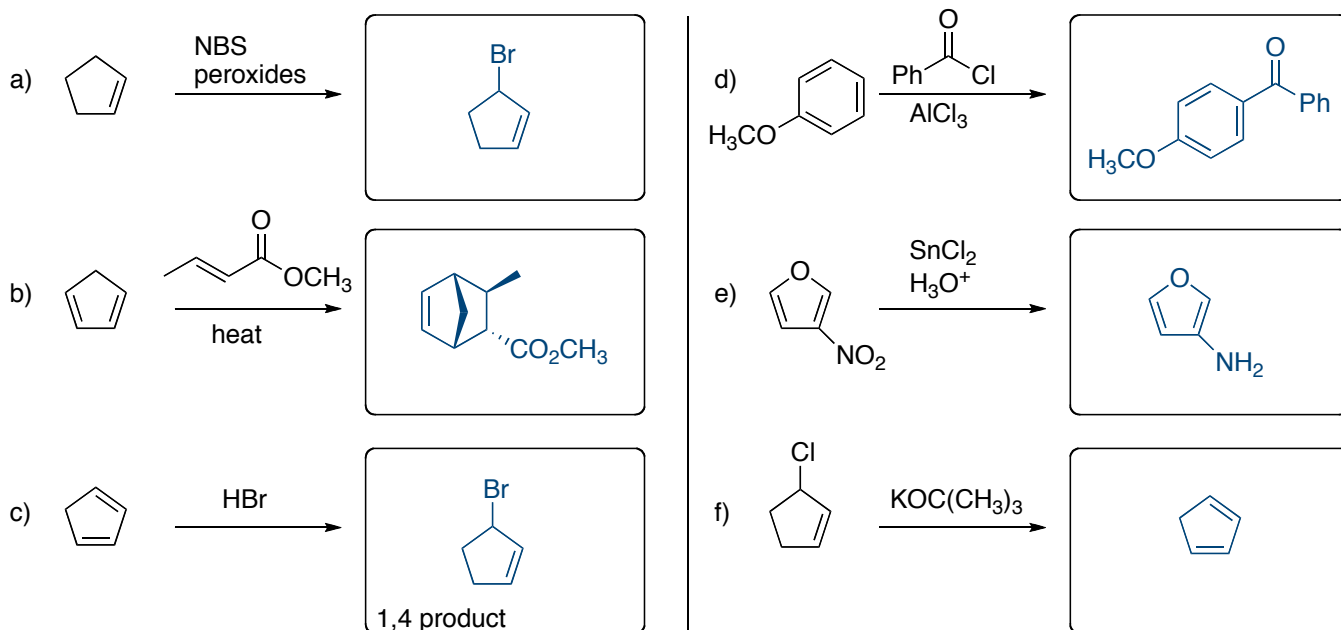
7. For each of the reactions below choose the best set of reagents from the list below to carry out the reaction. (Place the letter of the reagents A, B, etc. in the box. Note that there are more reagents in the list than you need for the problem.) (18 pts)



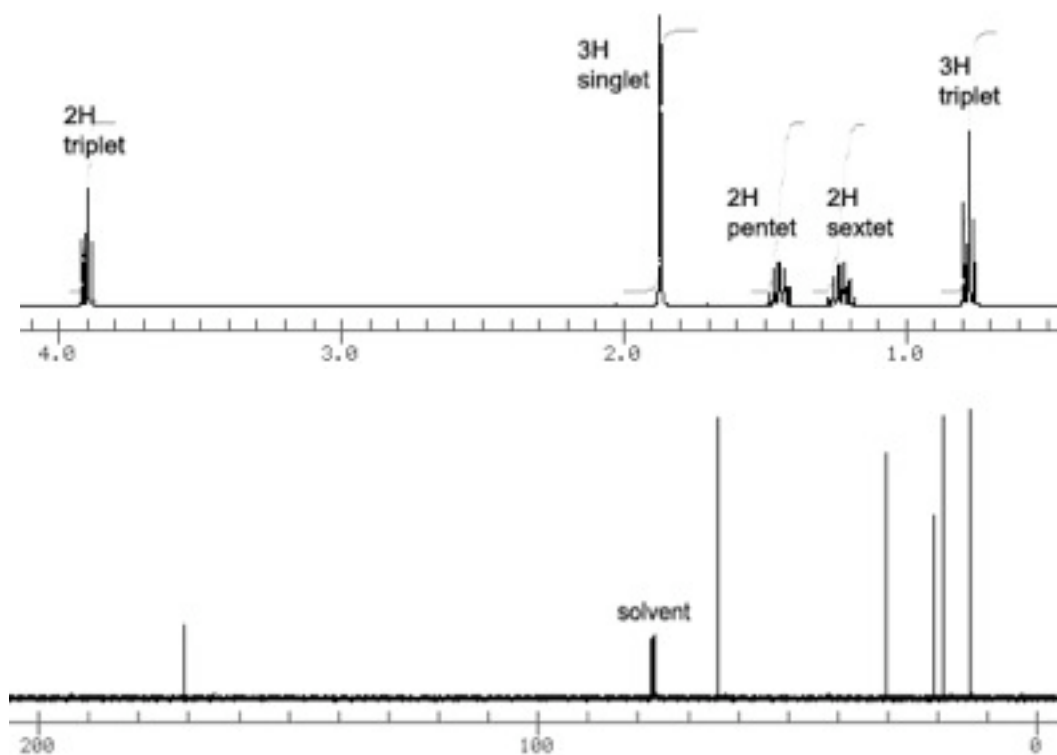
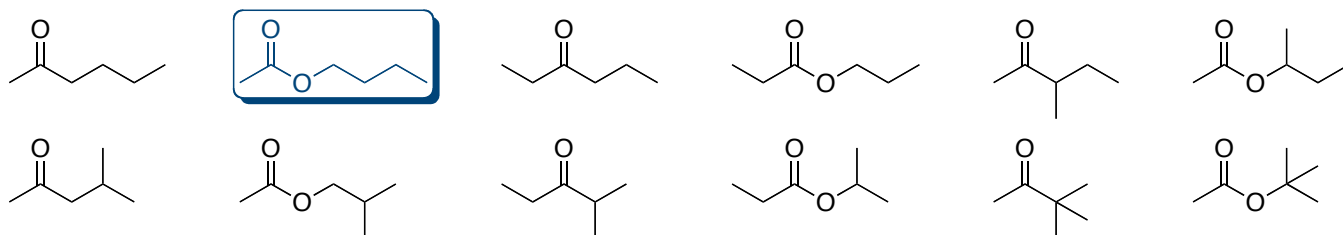
possible reagents

A. DIBAL-H then H_3O^+	E. $(\text{CH}_3)_2\text{CuLi}$	I. H_2O_2
B. KMnO_4	F. NaOH , heat	J. mCPBA
C. Br_2 , FeBr_3	G. PCC	K. H_2 , Pd/C
D. NaH , heat	H. HBr , heat	L. CH_3MgBr then H_3O^+

8. Provide the major organic product for each of the following reactions. Indicate proper stereochemistry where appropriate. (18 pts)



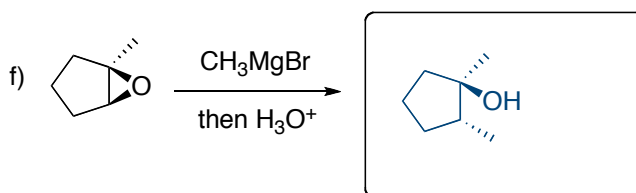
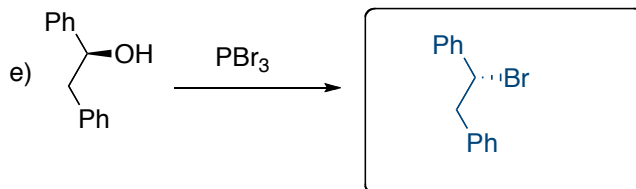
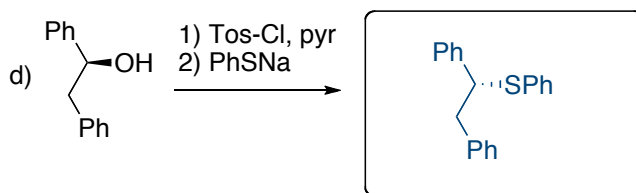
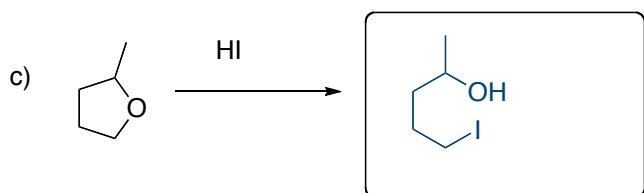
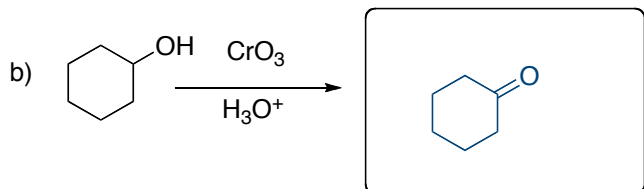
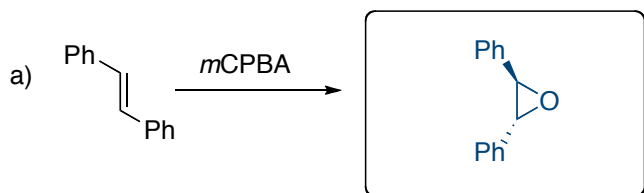
9. Circle the compound which best matches the following proton and carbon NMR data. (10 pts)



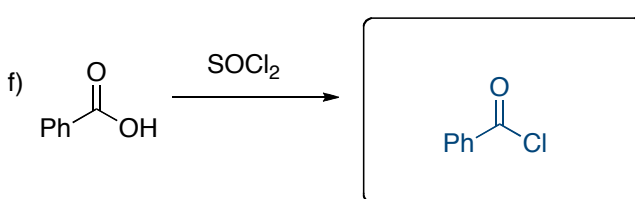
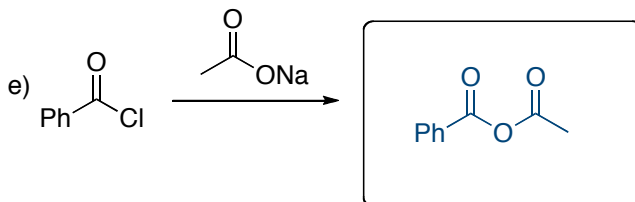
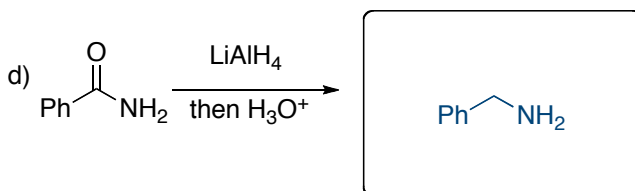
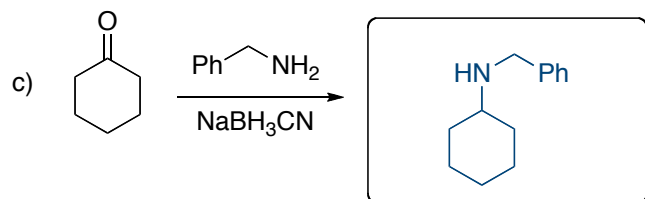
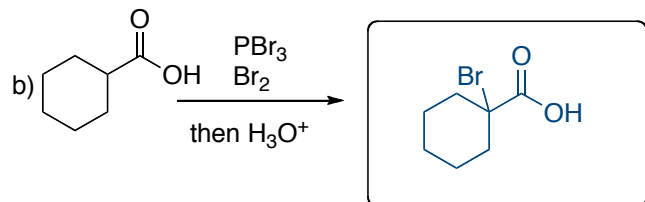
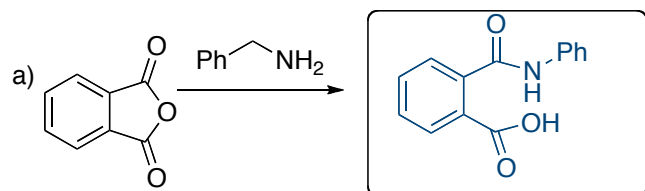
10. For each of the following molecules, indicate the number of different proton and carbon resonances you would observe in the NMR spectrum. (12 pts)

		# of ^1H signals	# of ^{13}C signals		# of ^1H signals	# of ^{13}C signals	
a)		4	5	d)		3	4
b)		5	5	e)		2	3
c)		4	5	f)		2	3

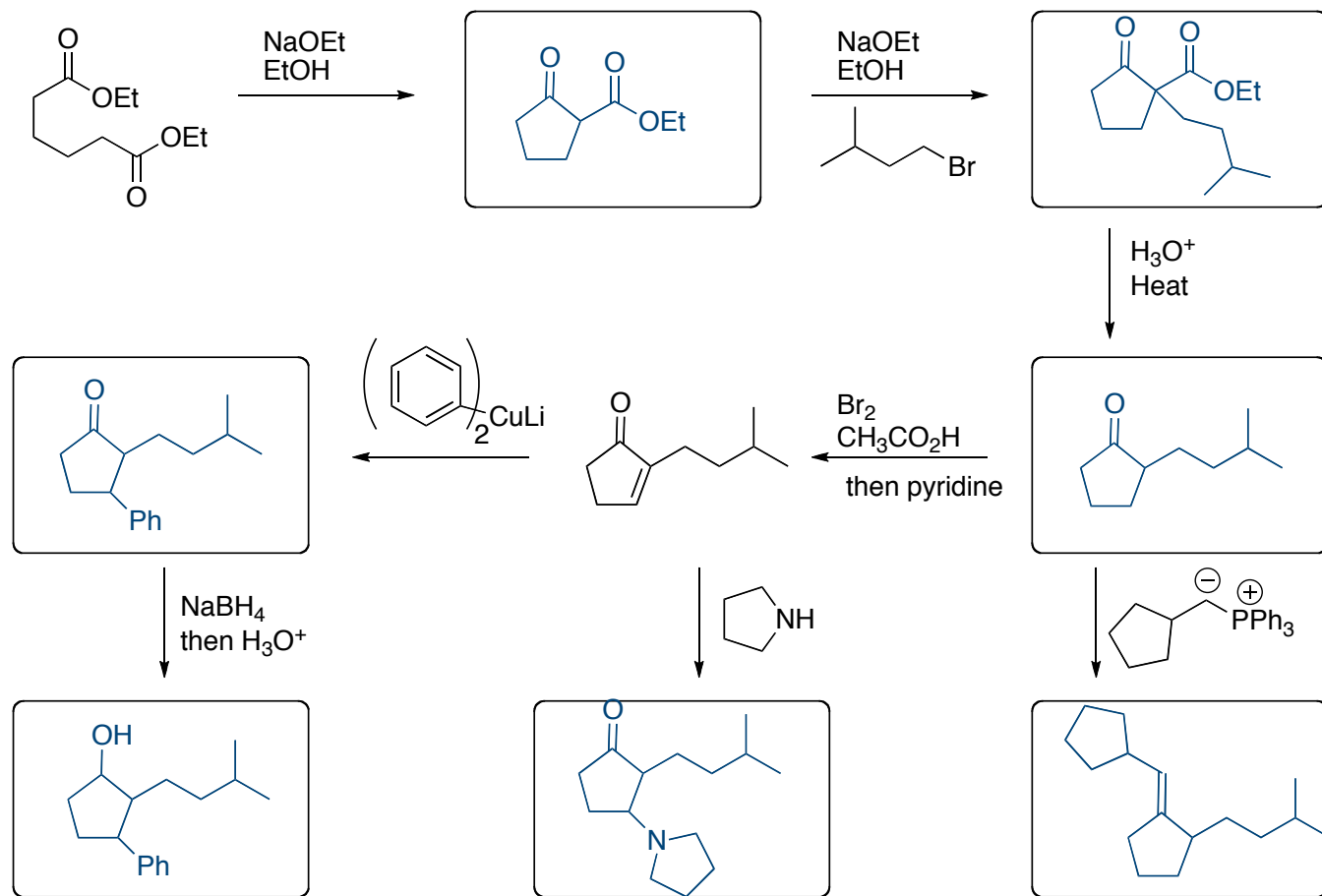
11. Provide the major organic product for each of the following reactions. Indicate proper stereochemistry where appropriate. (18 pts)



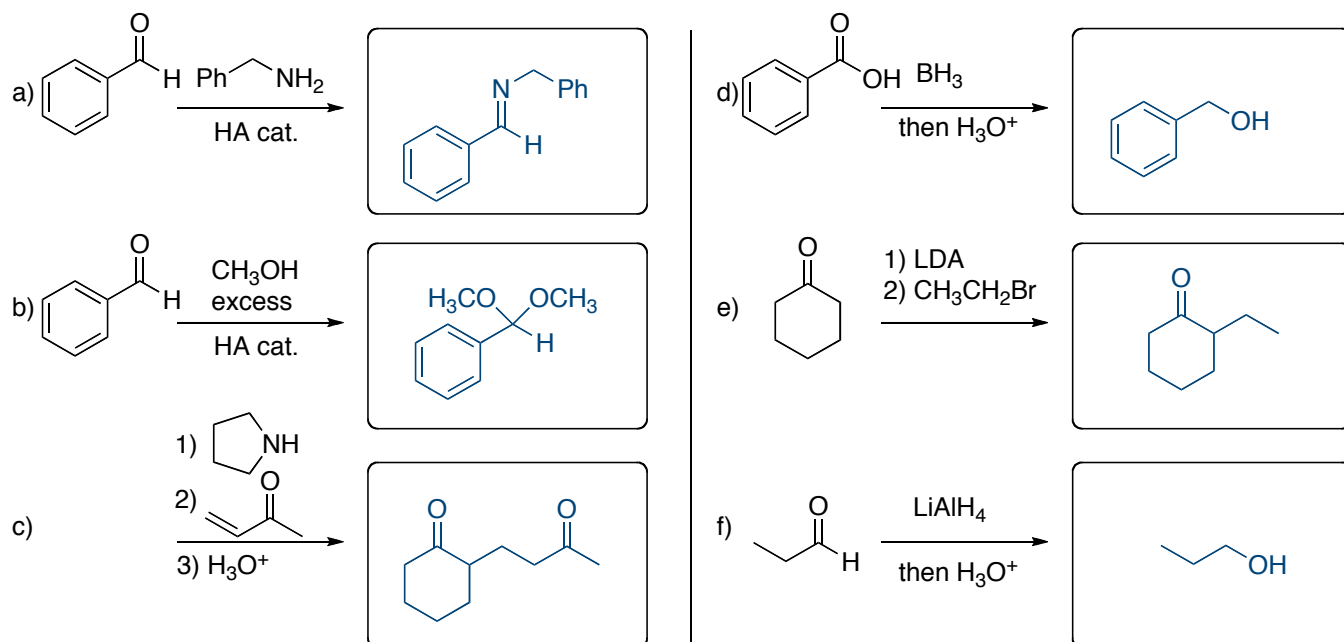
12. Provide the major organic product for each of the following reactions. (18 pts)



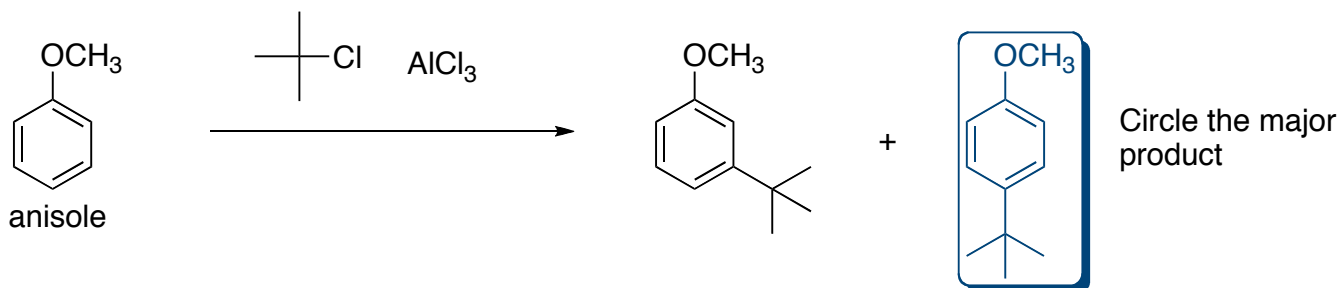
13. Provide the missing structures in the following synthetic sequence. Do not worry about showing stereochemistry. (21 pts)



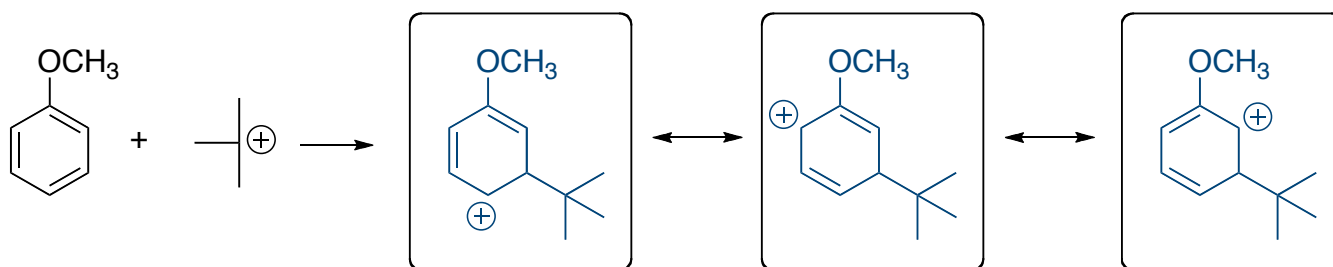
14. Provide the major organic product for each of the following reactions. (18 pts)



15. Friedel-Crafts alkylation reactions are directed by substituents on the aromatic ring. Shown below is the electrophilic aromatic substitution of anisole with *t*-butyl chloride. Circle the major product of this reaction. The mechanism involves a cationic intermediate. Complete the structures in the box for the intermediate in the reaction for the attack of the electrophile in the meta position. Show the location of the *t*-butyl group as well as all double bonds and charges for the resulting three resonance structures. (13 pts)

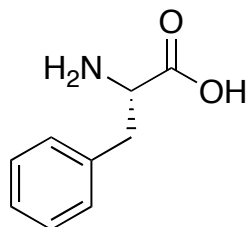


Draw addition of the electrophile to the meta position



BONUS QUESTIONS:

What is the name of the following essential amino acid? (5 pts)



phenylalanine

Briefly explain the following terms that we use describe protein structure: (5 pts)

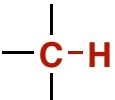
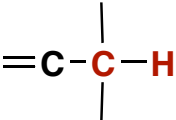
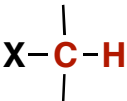
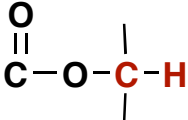
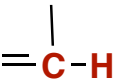
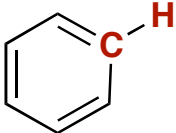
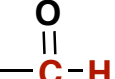

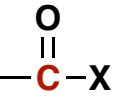
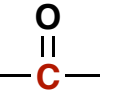
Primary Structure: **amino acid sequence**

Secondary Structure: **structural domains within the protein such as loops, beta sheets and alpha helices**

Tertiary Structure: **overall 3-dimensional shape of the protein - e.g. globular proteins**

Quaternary Structure: **structure of multiple protein complexes**

Typical NMR Chemical Shifts

Functional Group	Type	¹ H Chemical Shift (ppm)	¹³ C Chemical Shift (ppm)
	Alkane	0.7 - 1.8	10 - 60
	Allylic or next to carbonyl	1.6 - 2.4	30 - 60
	next to halogen or alcohol	2.5 - 4.0	20 - 85
	next to oxygen of an ester	4.0 - 5.0	50 - 85
	vinyl	4.5 - 6.5	110 - 150
	aromatic	6.5 - 8.0	110 - 140
	aldehyde	9.7 - 10.0	190 - 220
	alcohol	varies widely will exchange with D ₂ O	N/A
	carbonyl of ester, amide, or carboxylic acid (X = O, N)	N/A	165 - 185
	carbonyl of ketone or aldehyde	N/A	190 - 220