Name: _____

CHEM 322. Final Exam.

Spring 2011

Prof Donald Watson, Prof Mary Watson

Please write your answers clearly in the boxes provided. If your answer is illegible or outside the box, it will not be graded. You may use the back of test pages for scratch work.

You may use molecular models.

Use of calculators, cell phones, headphones, or any other electronic device during this exam is prohibited.

No notes or books may be used during this exam. Data tables are provided on pages 17 and 18 of this exam.

You may raise your hand to ask a question if you are not sure what is being asked of you.

There are 20 pages in this exam. Please check that your test has 20 pages before you begin. The last 2 pages are blank and may be used as scratch paper.

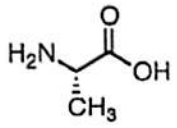
Please circle your lab section:

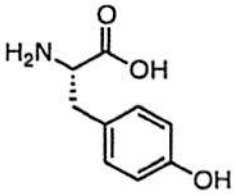
Mon 12:20–3:20 (Amber, 031)
Mon 3:35–6:35 (Tatsiana, 032)
Mon 7–10 (Craig, 033)
Tues 9:30–12:30 (Srimoyee, 020)
Tues 12:30–3:30 (Neo, 021)
Tues 3:30–6:30 (Peter, 022)
Tues 7–10 (Peter, 023)
Wed 12:20–3:20 (Tatsiana, 034)
Wed 7–10 (Tatsiana, 035)
Thurs 9:30–12:30 (Srimoyee, 024)
Thurs 12:30–3:30 (Neo, 026)
Thurs 3:35–6:35 (Srimoyee, 027)
Thurs 7–10 (Neo, 030)
Fri 9:05–12:05 (Amber, 036)
Fri 12:20–3:20 (Amber, 028)
Fri 3:35–6:35 (Jesse, 025)
Fri 7–10 (Jesse, 039)

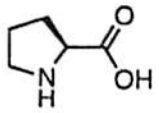
Question		Points
1	_____	/8
2	_____	/4
3	_____	/4
4	_____	/10
5	_____	/10
6	_____	/16
7	_____	/16
8	_____	/8
9	_____	/5
10	_____	/7
11	_____	/6
12	_____	/6
Total	_____	/100

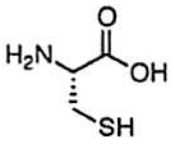
Name: _____

1. Please give the common name of the following amino acids.



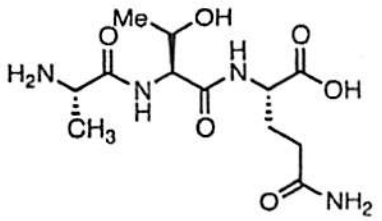




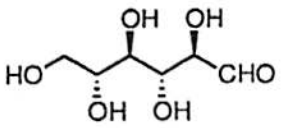


Name: _____

2. Please write the name of the following peptide using the 1-letter abbreviations for the amino acids.

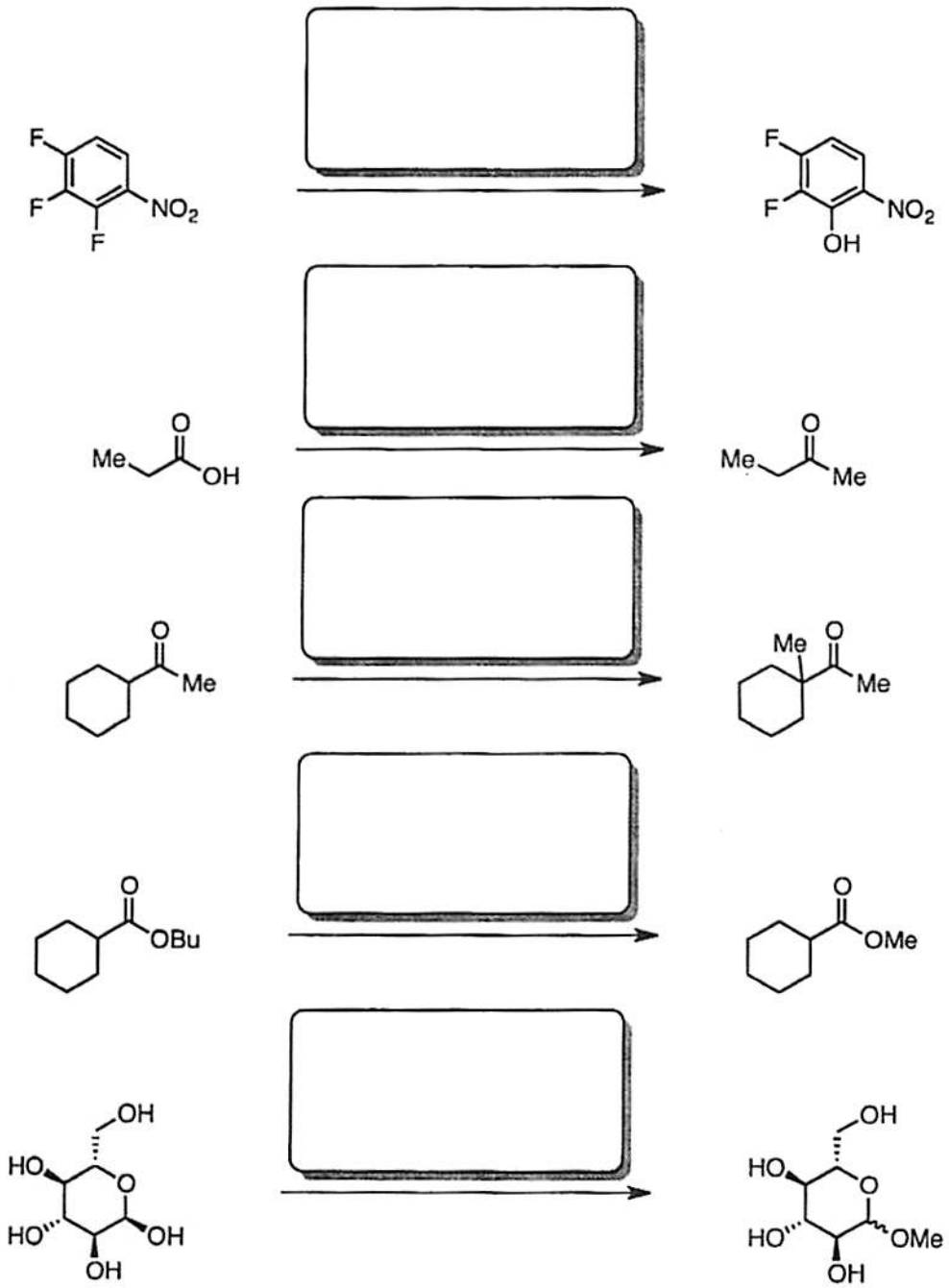


3. Complete the Fisher projection for the following molecule.



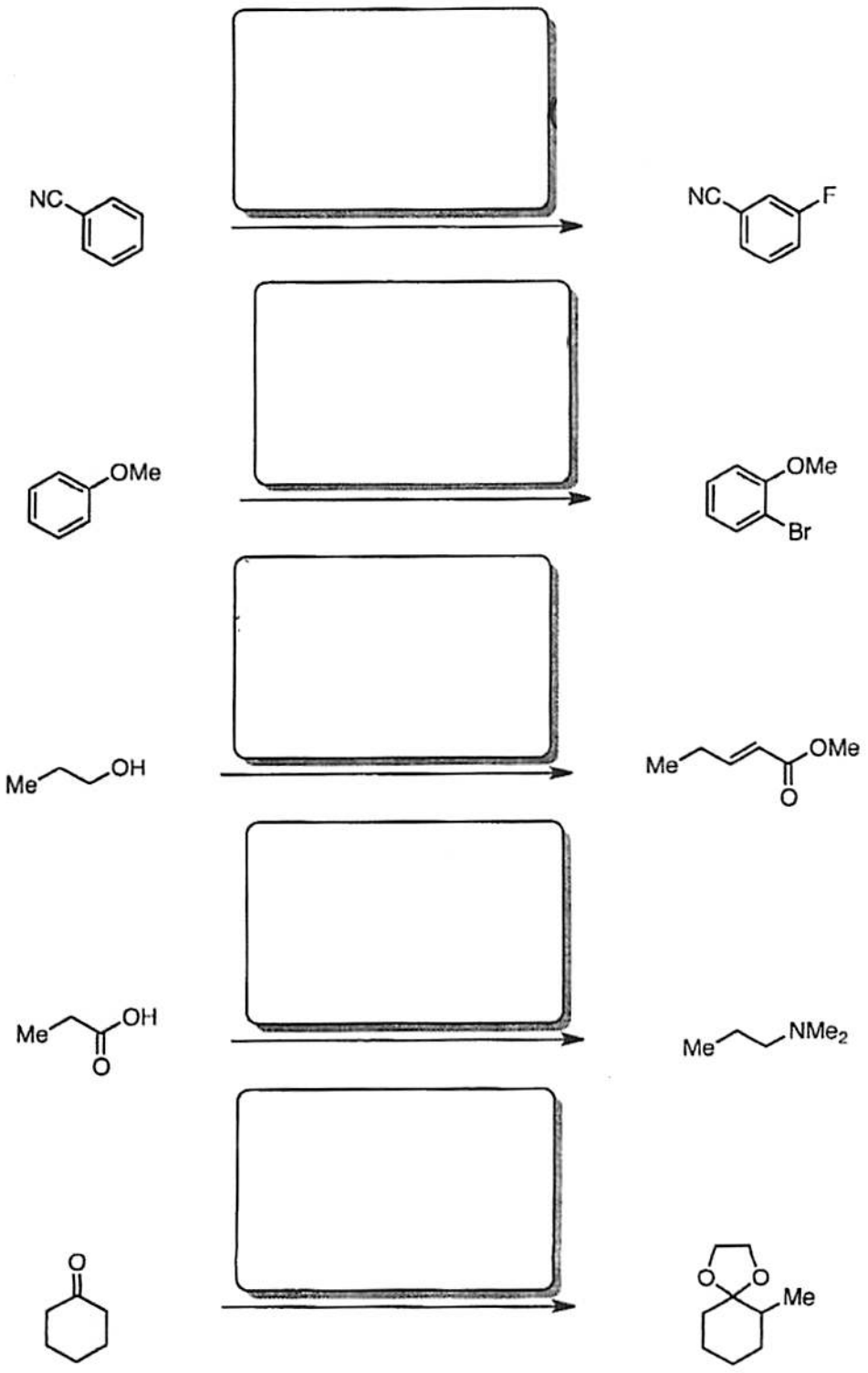
Name: _____

4. Provide reagents for the following transformations. In each case, only a single step is required.



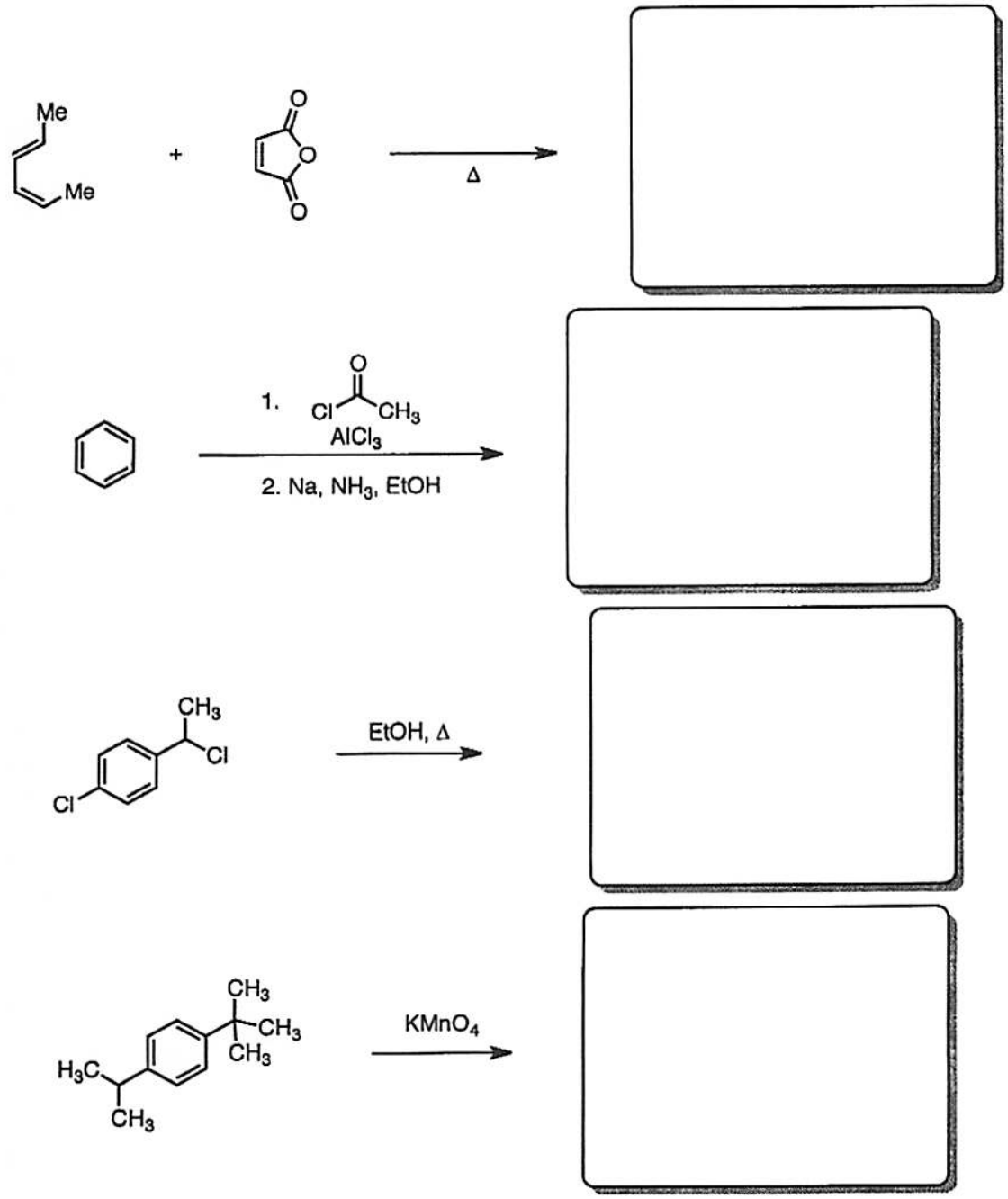
Name: _____

5. Provide reagents for the following transformations. In each case, multiple steps are required.



Name: _____

6. Please draw the expected major product for each of the following reactions. If no reaction is expected, write "No Reaction."



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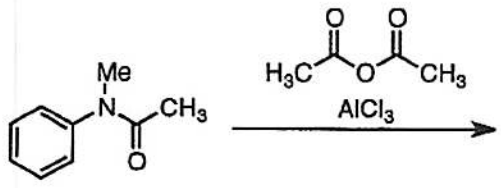
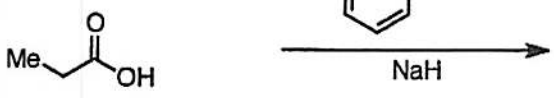
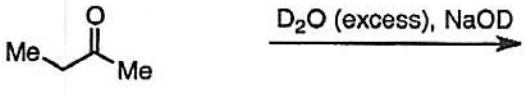
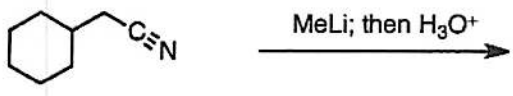
(6 – continued)



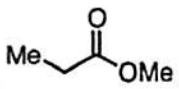




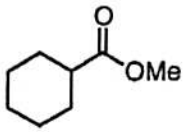


Name: _____

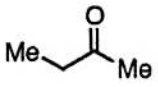
7. Please draw the expected major product for each of the following reactions. If no reaction is expected, write "No Reaction."



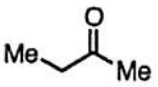
$MeONa$; then H_3O^+ →



$MeONa$; then H_3O^+ →



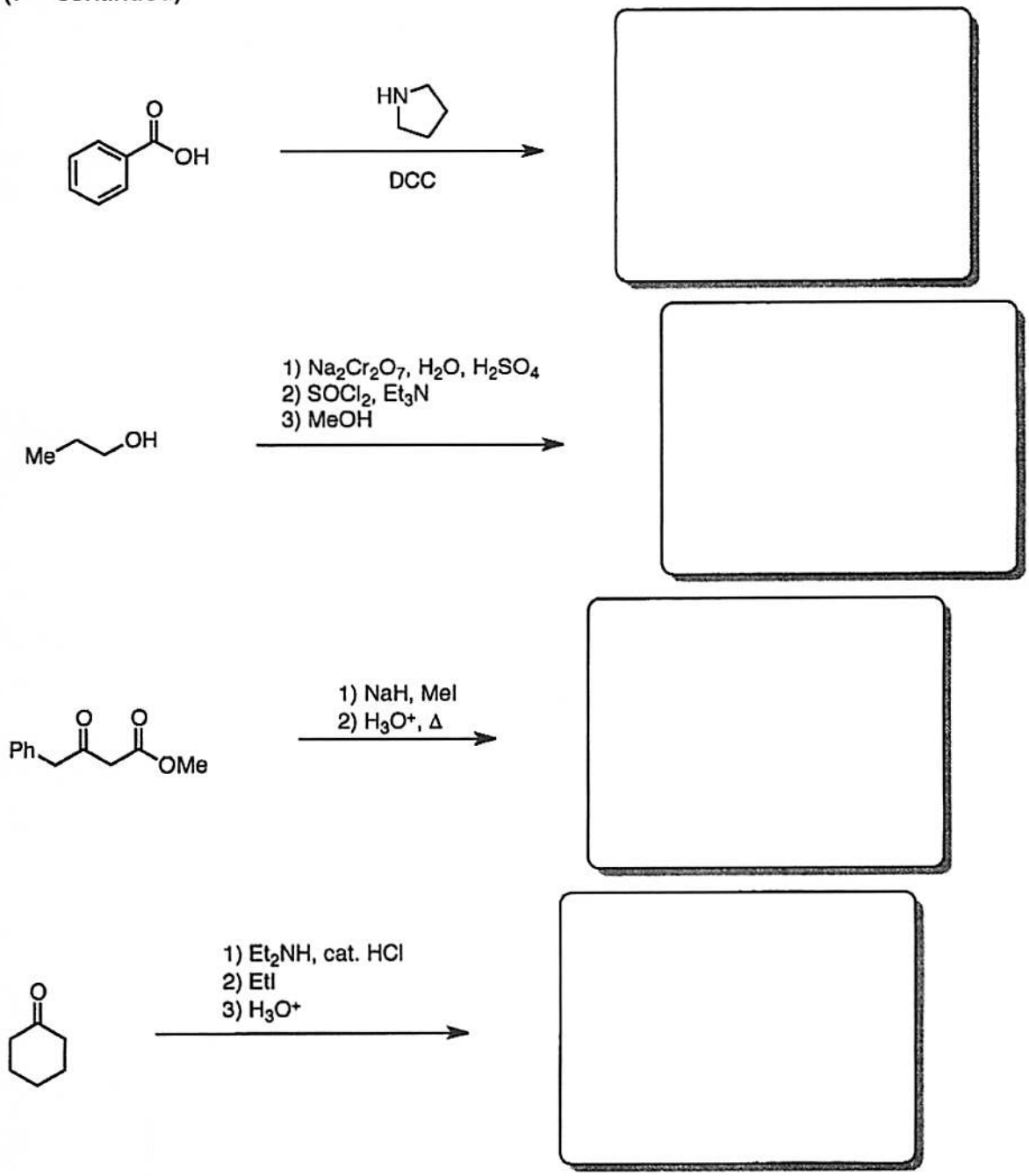
LDA; then BnBr →



NaH, MeI →

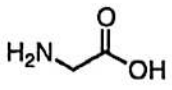
Name: _____

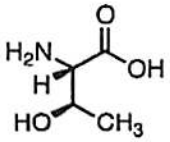
(7 – continued)

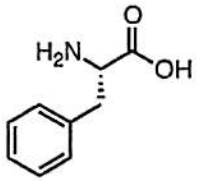


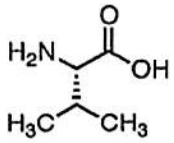
Name: _____

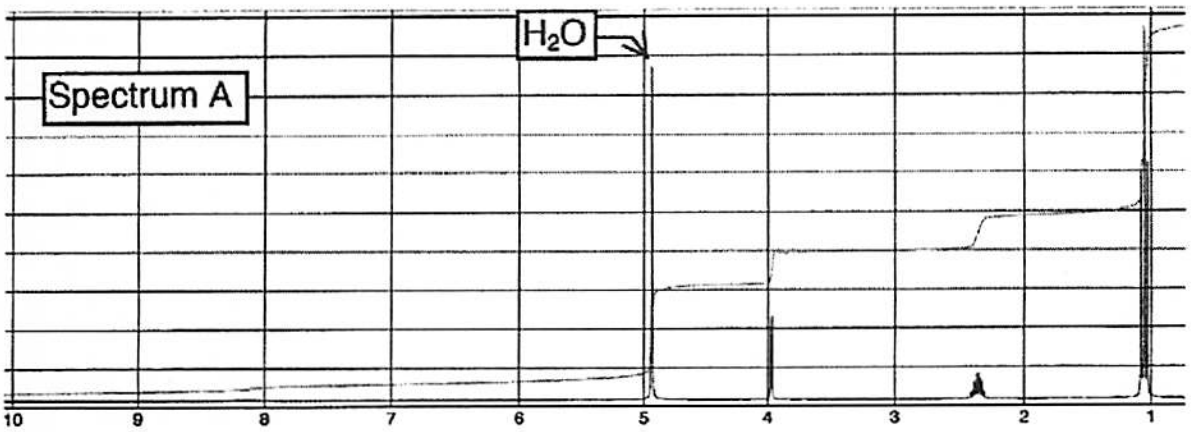
8. Match each of the following amino acids to its ^{1}H NMR spectrum. Write the letter of the spectrum in the box under the appropriate amino acid. Please note that H_2O is present in all these spectra (labeled as H_2O) and that none of the N–**H** or O–**H** protons are seen. No explanation is necessary.

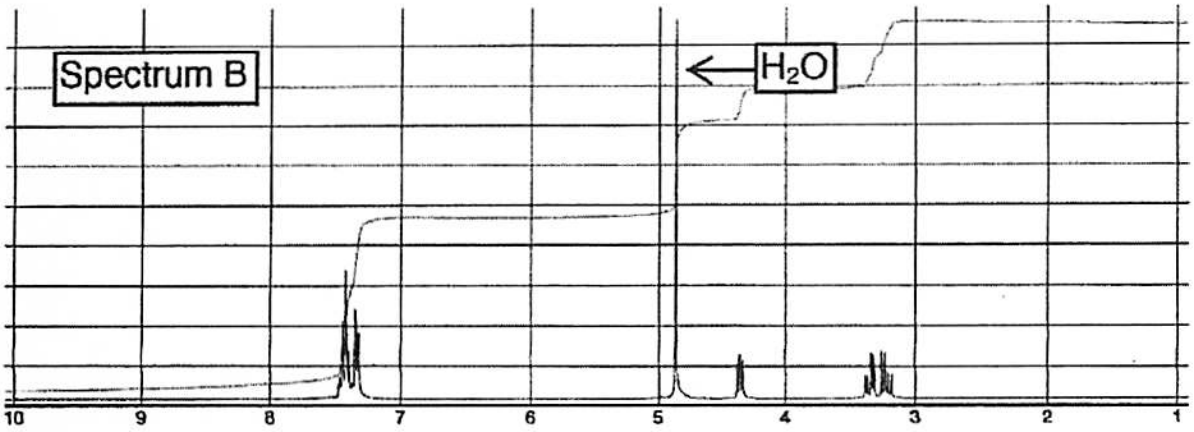






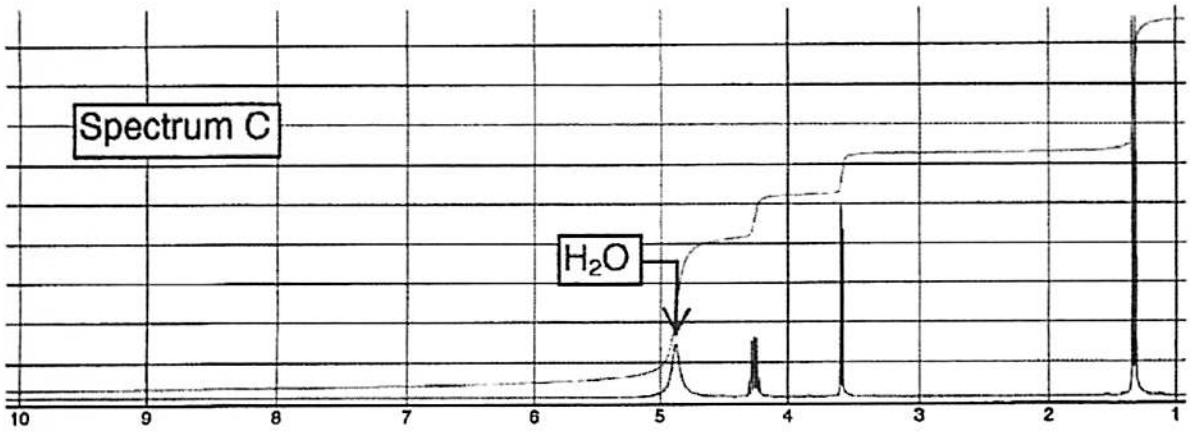


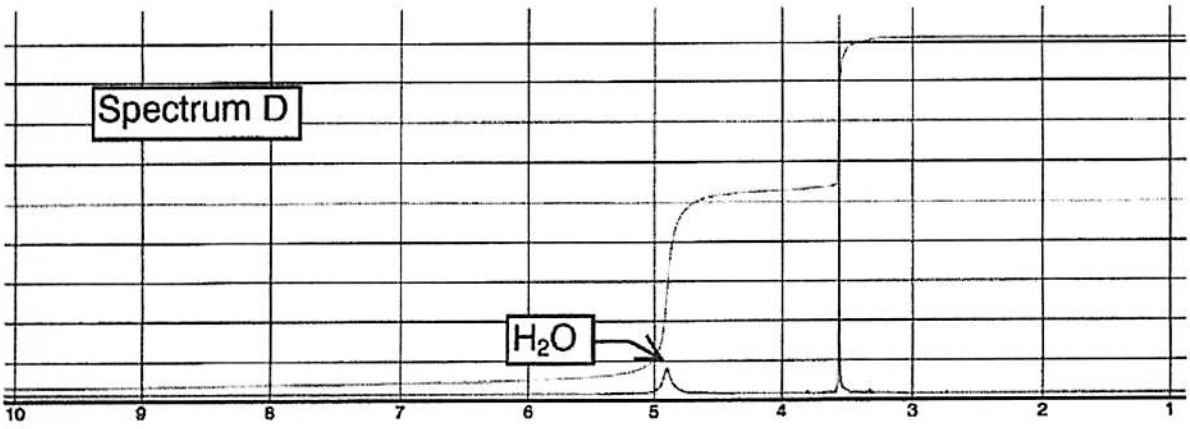




Name: _____

(8 – continued)

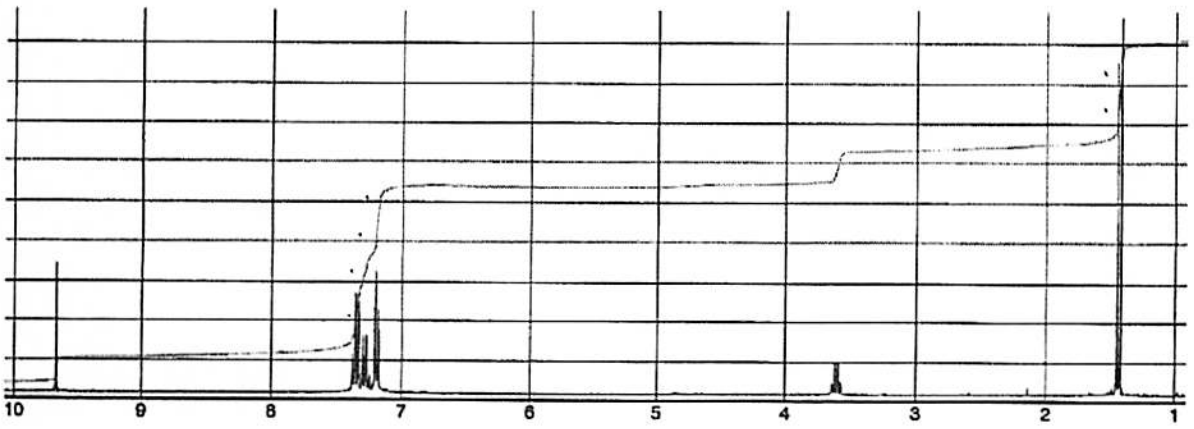




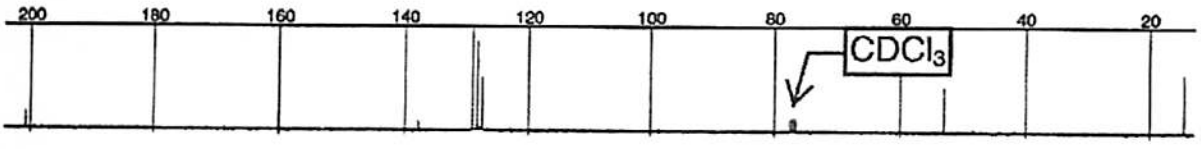
Name: _____

9. Shown below are the NMR and IR spectra and data of an unknown compound with a molecular formula of $C_9H_{10}O$. Based on this data, draw the structure of this unknown in the box below. No explanation is necessary.

^{1}H NMR spectrum ($CDCl_3$ as solvent):



^{13}C NMR spectrum ($CDCl_3$ as solvent):

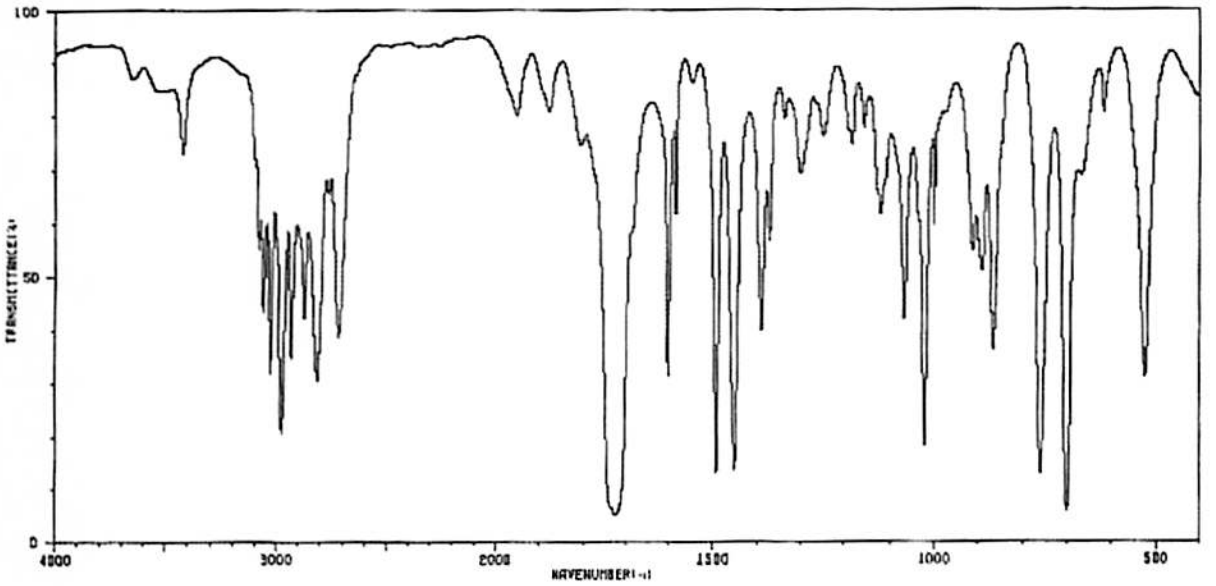


(IR spectrum is on the next page.)

Name: _____

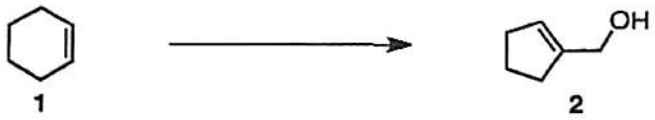
(9 – continued)

IR spectrum:



Name: _____

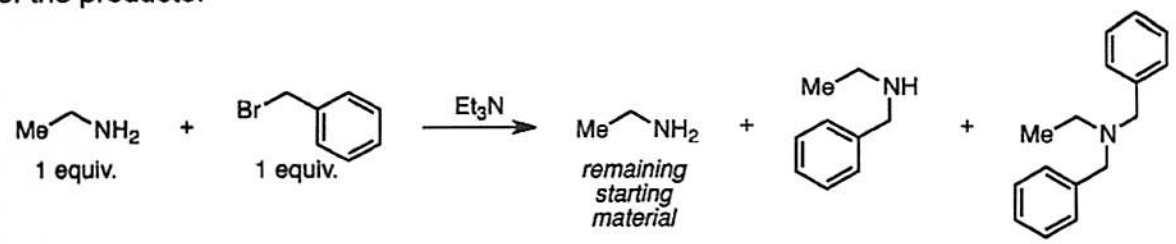
10. Please propose a synthesis of **2** using cyclohexene **1** as your only source of carbons in the product. You may use any other reagents you require. (No mechanism is required.)



1 **2**

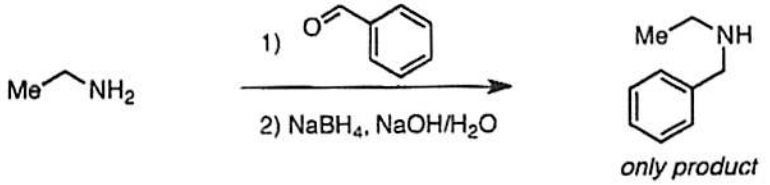
Name: _____

11. In general, alkylation of primary amines results in multiple products, as shown below. Please draw a reasonable, arrow-pushing mechanism for the formation of each of the products.



Name: _____

12. Reacting an amine with an aldehyde in the presence of $NaBH_4$ ("reductive amination") is a much more useful method for preparing alkylated amines, because only a single alkyl group is attached as shown below. Using your knowledge of carbonyl chemistry, please draw a reasonable, arrow-pushing mechanism for this transformation.



only product

Name: _____

Approximate IR Absorption Frequencies

Bond	Frequency (cm^{-1})	Intensity
O–H (alcohol)	3650–3200	Strong, broad
O–H (carboxylic acid)	3300–2500	Strong, very broad
N–H	3500–3300	Medium, broad
C–H	3300–2700	Medium
C≡N	2260–2220	Medium
C≡C	2260–2100	Medium to weak
C=O	1780–1650	Strong
C–O	1250–1050	Strong

Approximate ^{1}H NMR Chemical Shifts

Hydrogen	δ (ppm)
CH_3	0.8–1.0
CH_2	1.2–1.5
CH	1.4–1.7
C=C–CH_x	1.7–2.3
O=C–CH_x	2.0–2.7
Ph–CH_x	2.3–3.0
≡C–H	2.5
R_2N–CH_x	2.0–2.7
I–CH_x	3.2
Br–CH_x	3.4
Cl–CH_x	3.5
F–CH_x	4.4
O–CH_x	3.2–3.8
C=CH	4.5–7.5
Ar–H	6.8–8.5
O=CH	9.0–10.0
ROH	1.0–5.5
ArOH	4.0–12.0
RNH_x	0.5–5.0
$CONH_x$	5.0–10.0
RCOOH	10–13

Approximate ^{13}C NMR Chemical Shifts

Carbon	δ (ppm)
Alkanes	
Methyl	0–30
Methylene	15–55
Methine	25–55
Quaternary	30–40
Alkenes	
C=C	80–145
Alkynes	
C≡C	70–90
Aromatics	110–170
Benzene	128.7
Alcohols, Ethers	
C–O	50–90
Amines	
C–N	40–60
Halogens	
C–F	70–80
C–Cl	25–50
C–Br	10–40
C–I	–20–10
Carbonyls, C=O	
R_2C=O	190–220
RXC=O (X = O or N)	150–180