CHM 2120A
Midterm #2
November 17, 2011
Professor: A. Flynn

ANSWERS

First Name: _____ Last Name: _____

Student Number: _____

Seat number: _____

Approximate total number of marks: 66

Notes:

The marks are given as a guide and are subject to minor changes.
You can write in pen or in pencil.
The use of molecular models is permitted but they cannot be shared.
The use of faculty-approved calculators and rulers is permitted but they cannot be shared.

1a	2a	3b	4b	5b	6b	7b		8		1b	2b	3a	4a	5a	6a	7a	0
1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89 Ac	104 Rf	105 Ha	106 106												

1. Decide whether each of the following represent an oxidation or a reduction reaction. **(2 points)**

a.

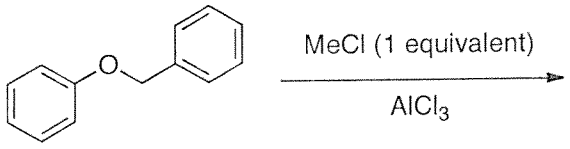
reduction (1)

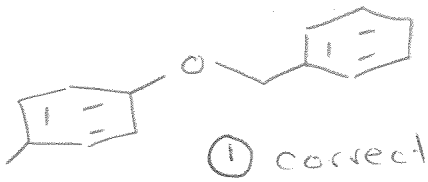
b.

reduction (1)

2. Give the major product(s) for each of the following reactions:

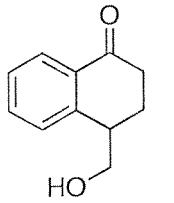
a. **(2 points)**



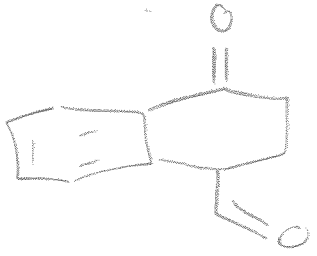


(1) correct ring
(1) correct isomer

b. **(2 points)**

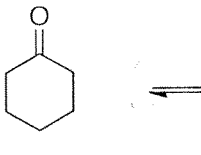


PCC

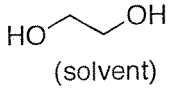


(1) [O]
(1) stop @ aldehyde

3. An intermediate in the following reaction is shown below. Complete the mechanism and provide the structure of the major organic product. **(6 points)**

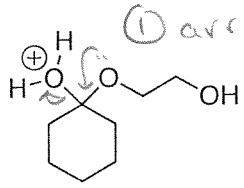


$H^{\oplus}$

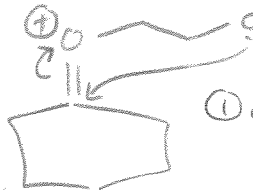


(solvent)

(1) arrows

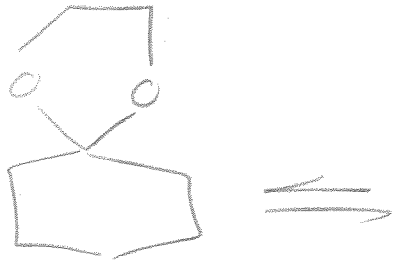


intermediate

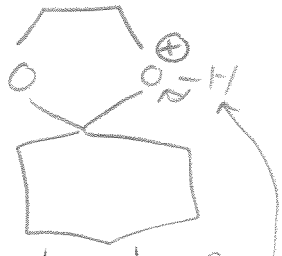


(1) arrows

(1) structure



(1) structure



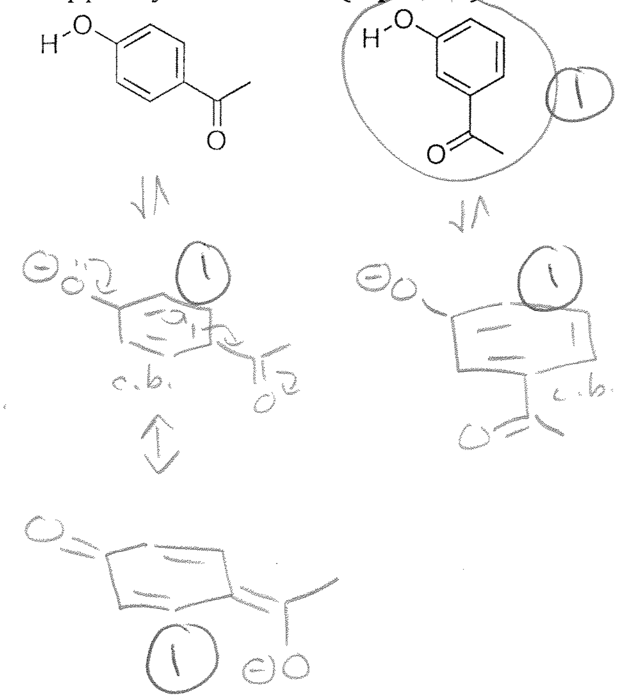
(1) structure
(1) arrows
Base:

HO—OH, H_2O

4.

a. Circle the weakest acid of the pair. **(1 point)**

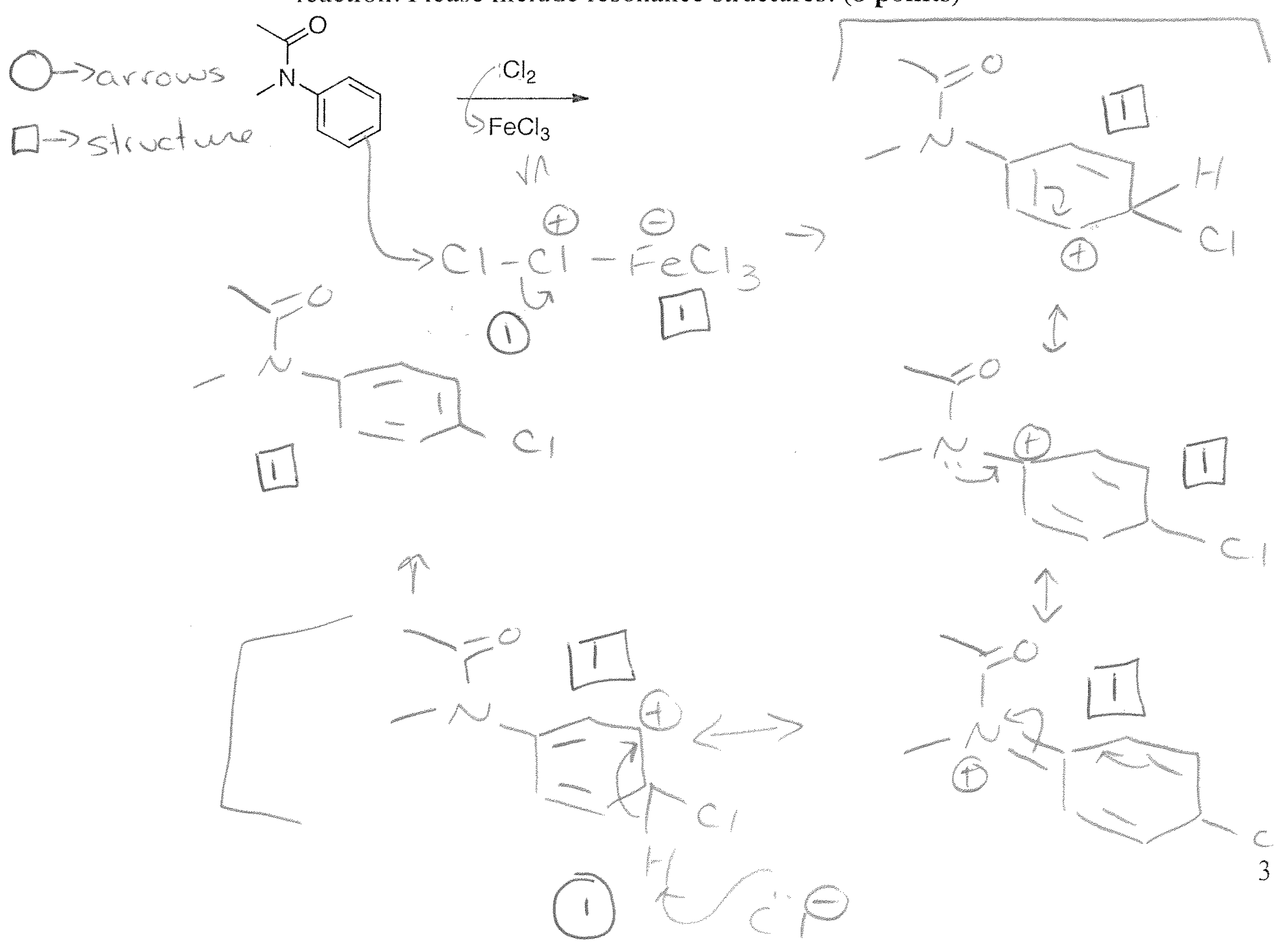
b. Clearly justify your answer and include the key structures that support your answer. **(5 points)**



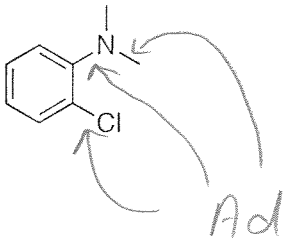
Resonance-stabilized c.b. with ketone + ring (1) → more stable c.b.

c.b is resonance (1) - stab'd w/ the ring only → less stable c.b.

5. Propose a mechanism for the formation of the major product of the following reaction. Please include resonance structures. **(8 points)**



6. Propose a synthesis of the following compound starting from benzene. Include an analysis (bonds broken, bonds formed/groups added, regiochemistry, stereochemistry). It is not necessary to include mechanisms. **(14 points)**



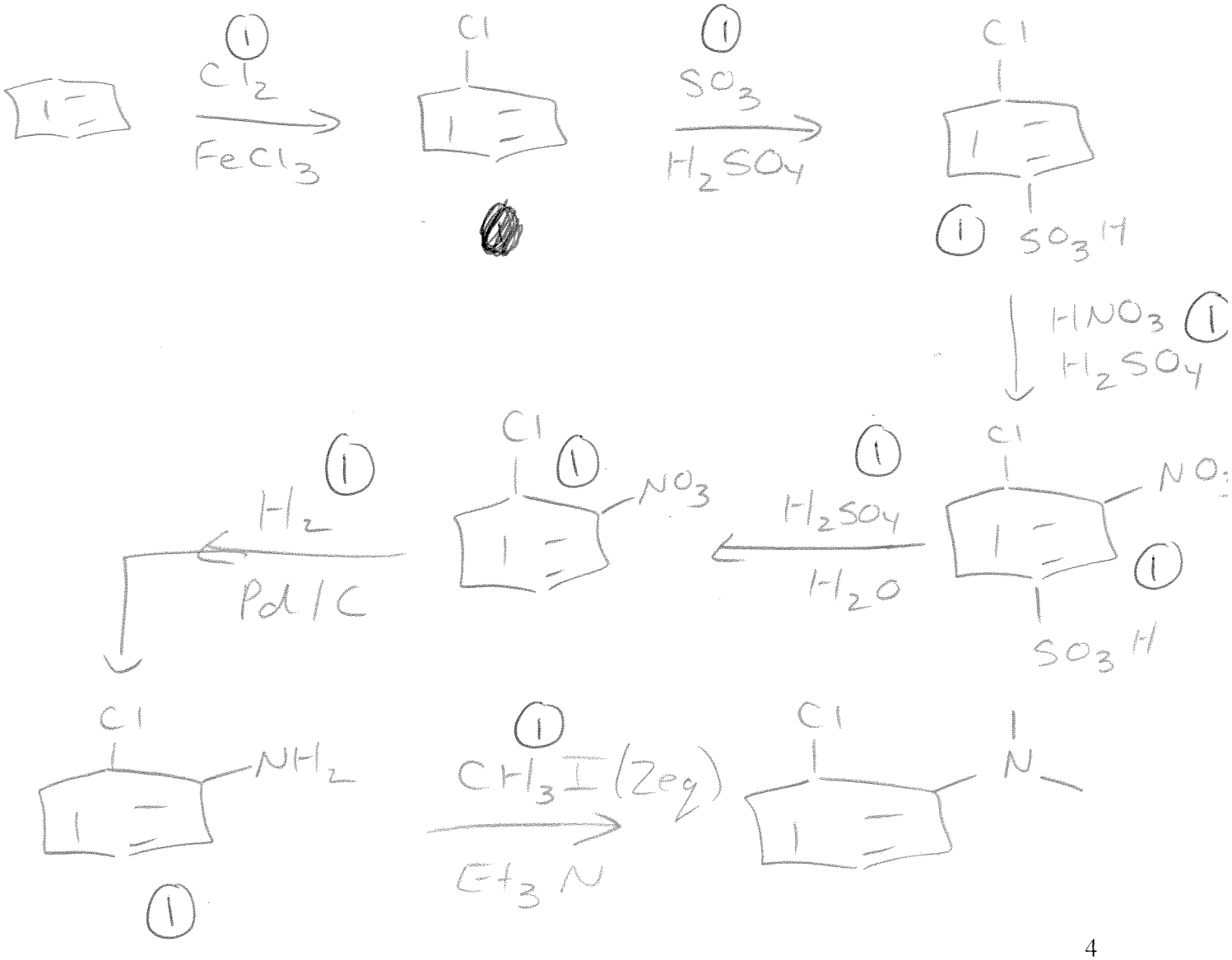
Bonds broken: π (1)

Added (2)

Regiochem: ortho (1)

Stereochem: N/A –

Synthesis



7. Consider the following reaction coordinate diagram, in which **C** is the starting material. **(4 points)**

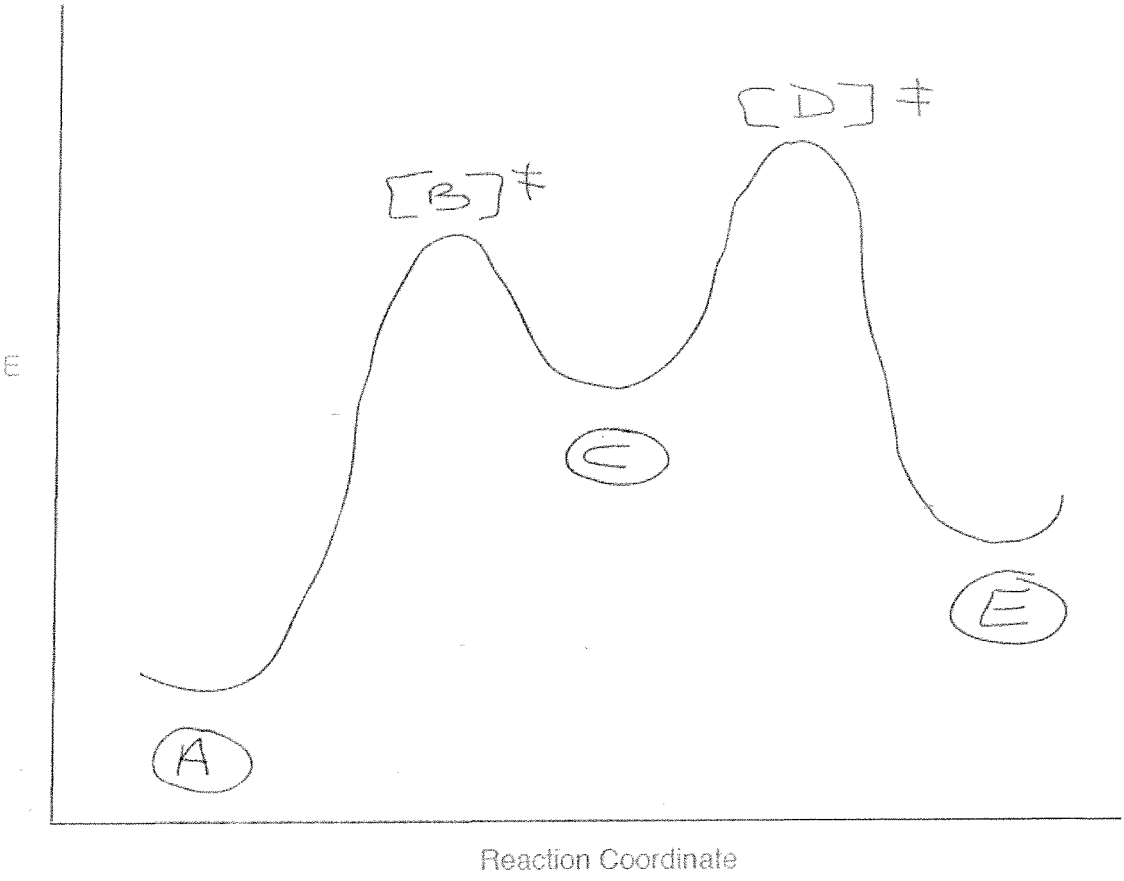
   a. Which is the most stable final product? A (1)

   b. Which final product forms the fastest? A (1)

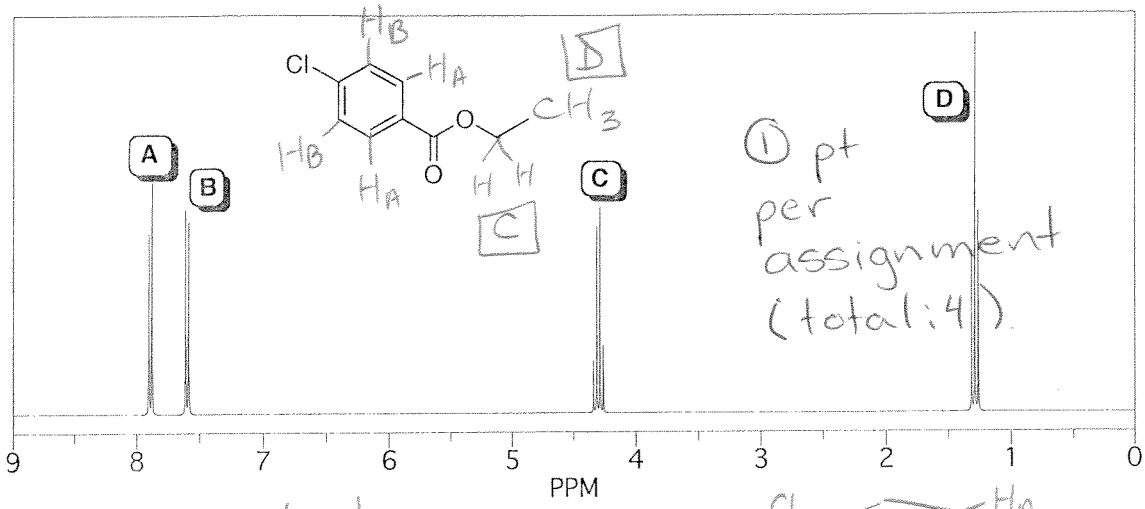
   c. Which structure does [B] most closely resemble? C (1)

   d. In one sentence, explain your answer in part c.

[B]‡ most closely resembles the species closest in energy to it. (1)

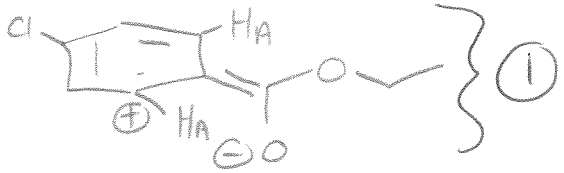


8. Assign each of the signals in the ^{1}H NMR spectrum shown below to protons in the structure shown. For the aromatic signals, briefly explain your answer using structures as appropriate. **(6 points)**

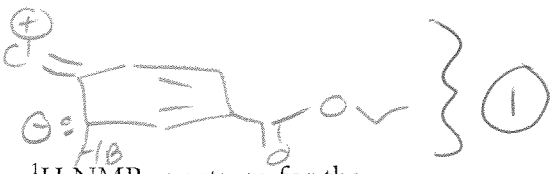


1 pt per assignment (total: 4)

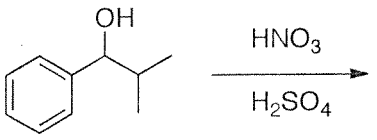
H_As are deshielded by resonance: (ω: E)



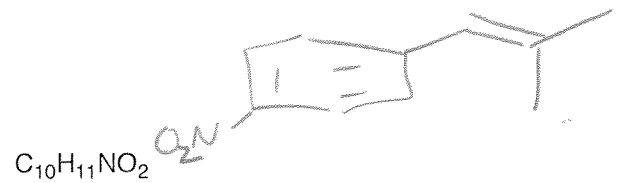
H_Bs are shielded by resonance: (ω: Cl)



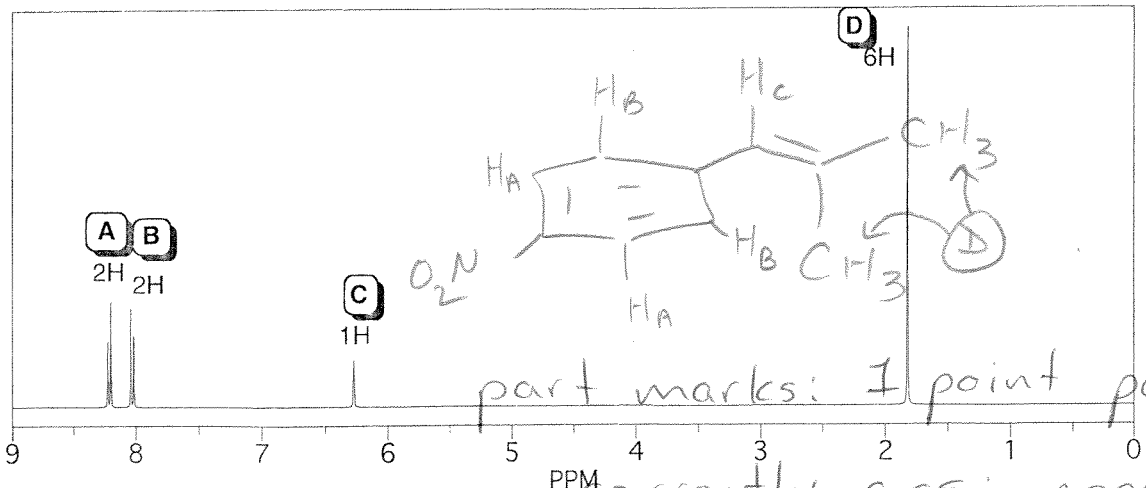
9. Draw the major product of the following reaction. The ^{1}H NMR spectrum for the major product is shown below. Part marks will be awarded for correctly assigning the NMR signals to structure in the product. **(4 points)**



$C_{10}H_{11}NO_2$

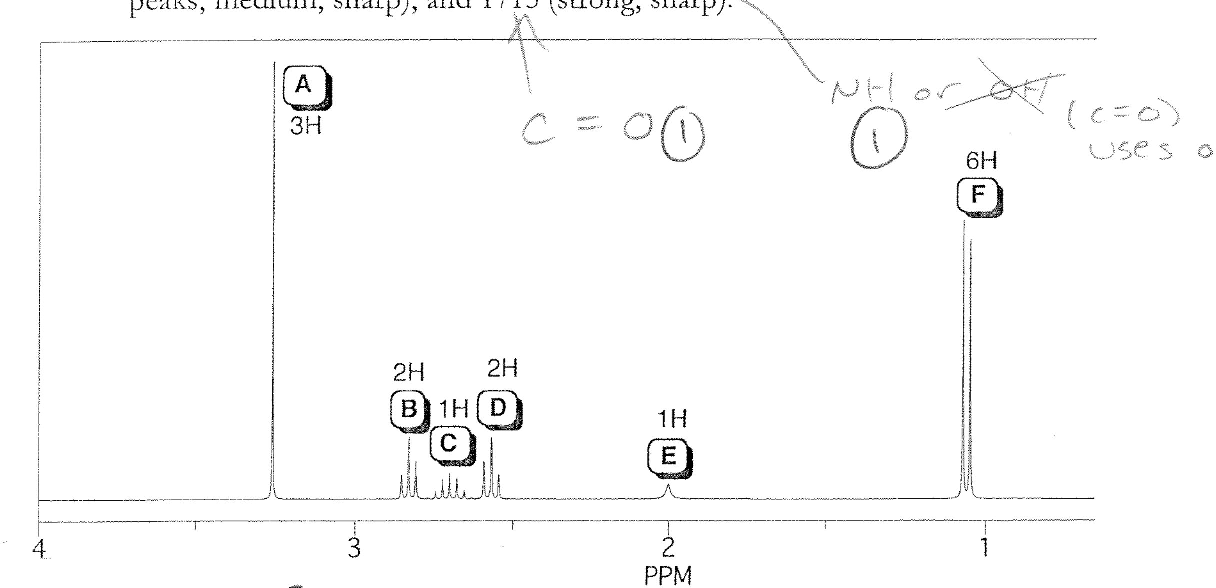


4



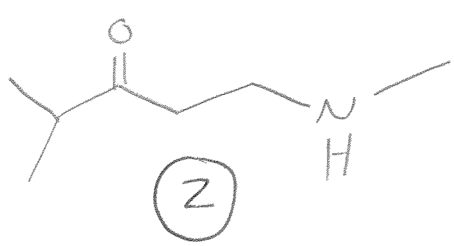
part marks: 1 point per correctly assigned signal

10. What is the structure of the unknown compound whose molecular formula is **$C_7H_{15}NO$**? The ^1H NMR spectrum of this compound is below. **(12 points)** The IR shows the following peaks: 3400 cm^{-1} (strong, broad), ~2940 cm^{-1} (multiple peaks, medium, sharp), and 1715 (strong, sharp).

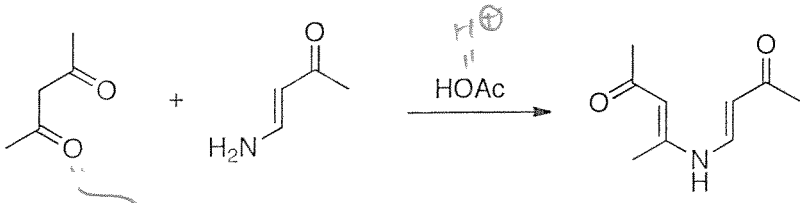


Signal	δ (ppm)	# H's	Multi-plicity	Comments/Ideas
A	~3.3	3H	s	CH_3 (1)
B	~2.8	2H	t	$C\underline{H_2}-CH_2$ (1) — together with D
C	~2.7	1H	m	CH (1) — together with F
D	~2.6	2H	t	$C\underline{H_2}-CH_2$ (1)
E	~2.0	1H	(br)s	NH (1)
F	~1.1	6H	d	$2 \times C\underline{H_3}-CH$ (1)

DU = 1 (1)



BONUS! **(3 points)**
Provide a mechanism for the following transformation:



(Eventually, a substituted pyridine is formed)