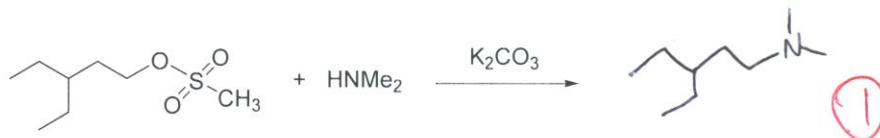


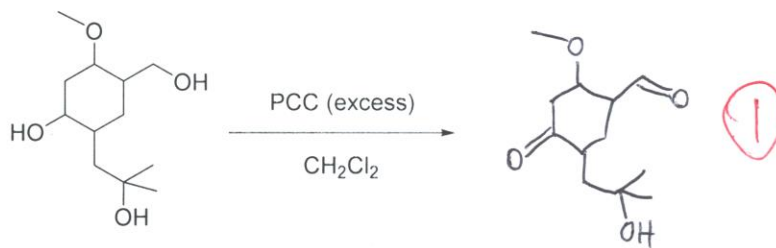
1. a) Draw the structure of the major product. (1 point)



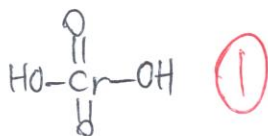
b) Draw the structure of the major product. (1 point)



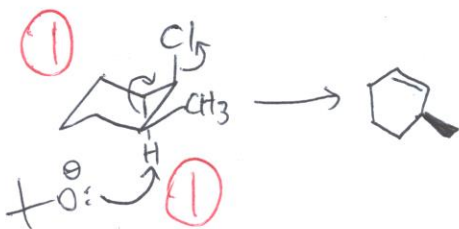
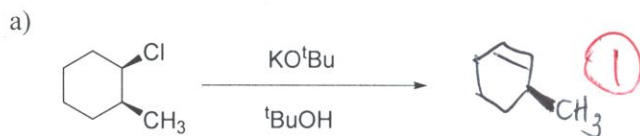
c) Draw the structure of the major product. (1 point)

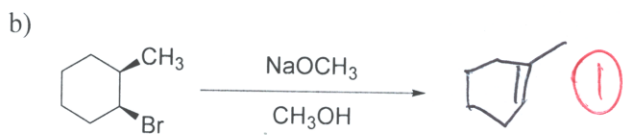


d) Draw the structure of chromic(VI) acid, the active oxidant in Jones Reagent (1 point)

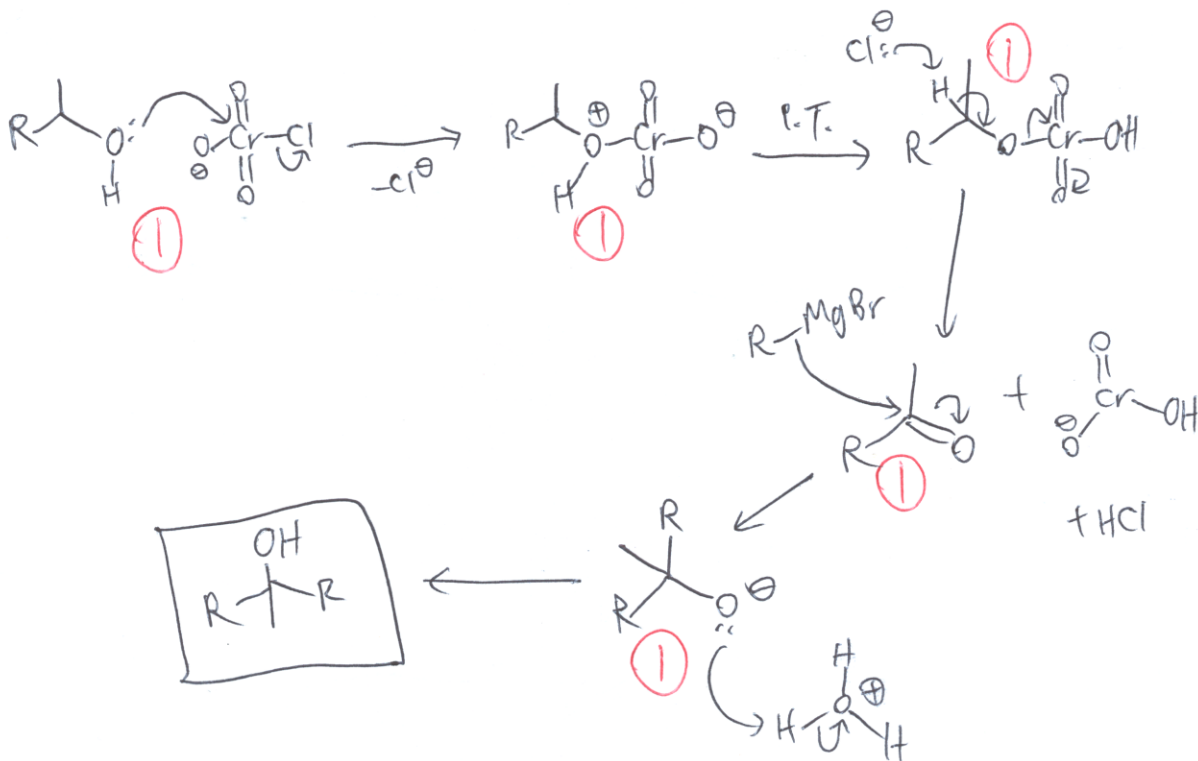
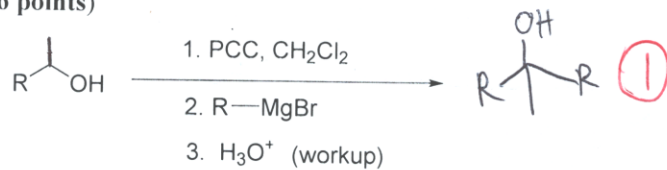


2. For each reaction below, draw the major elimination product as well as the reaction mechanism. In your mechanism, reactive chair conformations must be shown. (6 points)

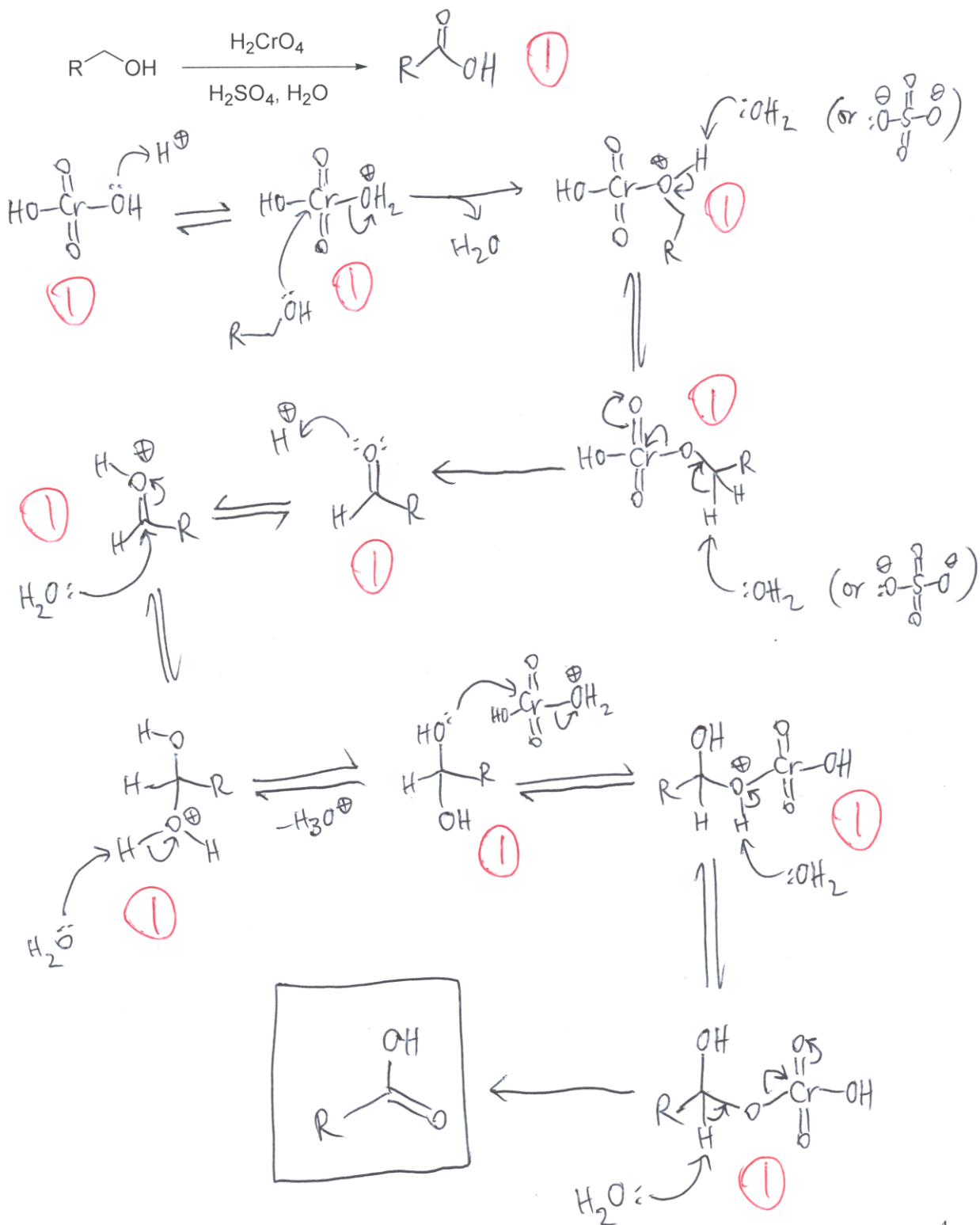




3. a) Give the product of the following reaction sequence, and draw the full mechanism for all three steps: (6 points)

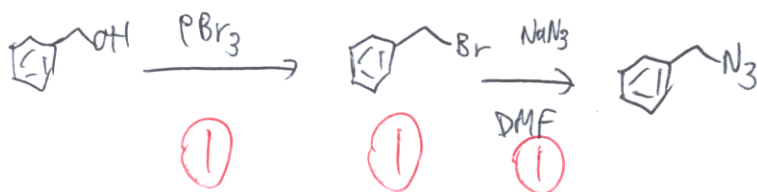


3. b) Draw the product of the following reaction, and draw the full mechanism for its formation. (11 points)

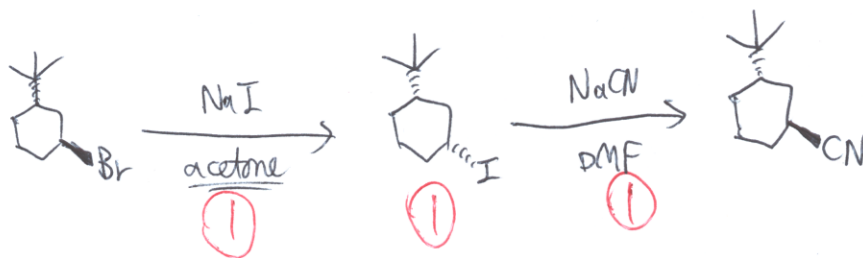
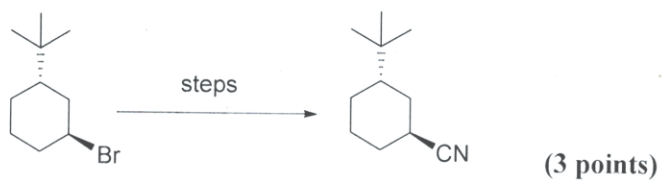


4. Propose a synthesis of the following compounds. Show all required reagents/solvents and intermediates. Retrosynthesis and mechanisms need not be shown.

a)

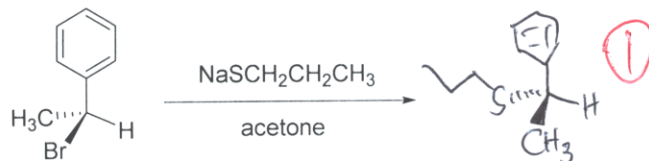


b)



5. Draw in the missing major product or reagent(s): (2 points)

a)



b)



6. Circle the species in each of the following pairs that would react faster by S_N2 . (7 points)

a)

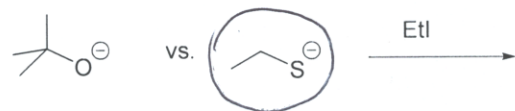


① each

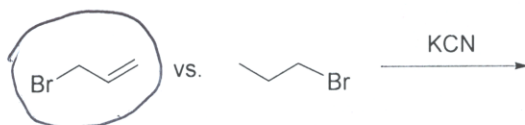
b)



c)

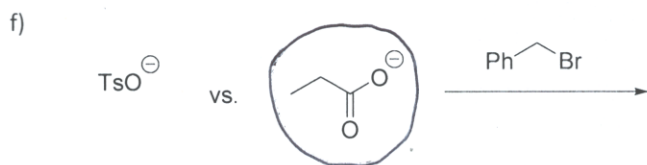


d)



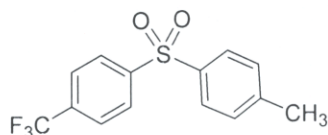
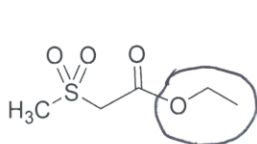
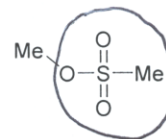
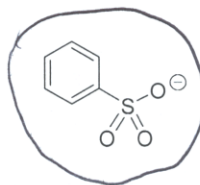
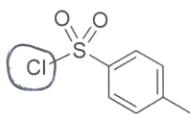
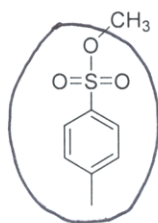
e)



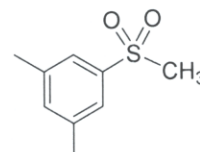
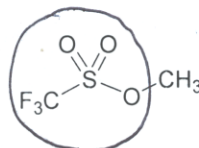


7. For each structure, circle the best leaving group (LG). This LG can be part of the structure or the entire structure. If the structure is not a LG, or does not contain a LG, write "No LG" below it.

(8 points) ① each



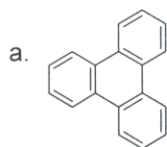
No LG



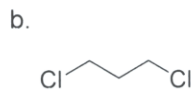
No LG

8. How many unique proton signals would be expected in the ^1H NMR spectrum of the following molecules? (5 points)

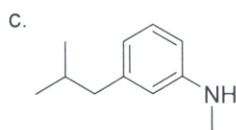
① each



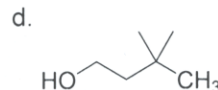
2



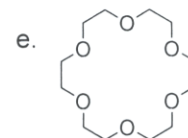
2



9

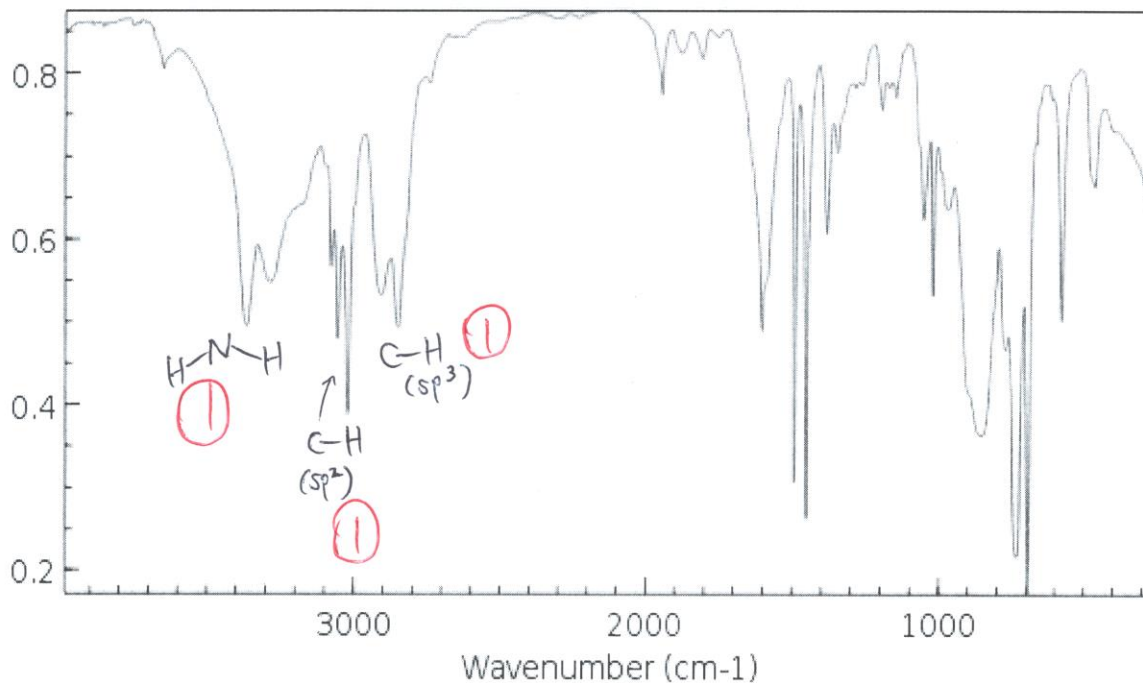


4



1

9. An unknown compound has a formula of C_7H_9N . Its IR spectrum is shown below:

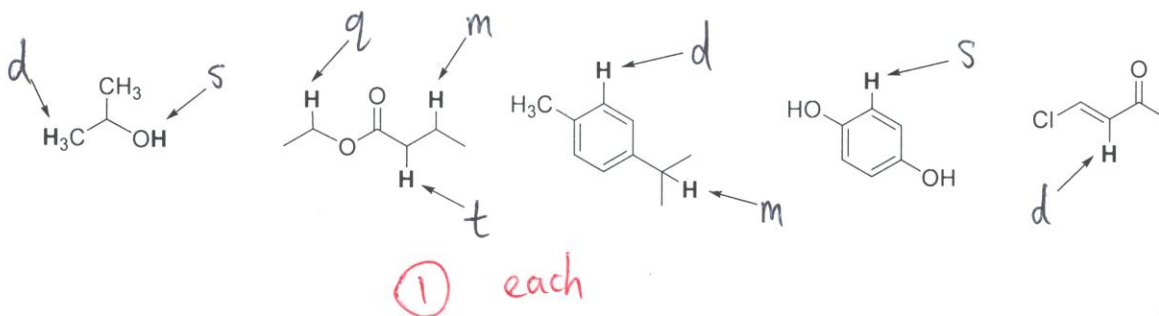


a. Determine the degree of unsaturation, *showing your full calculation clearly*. (1 point)

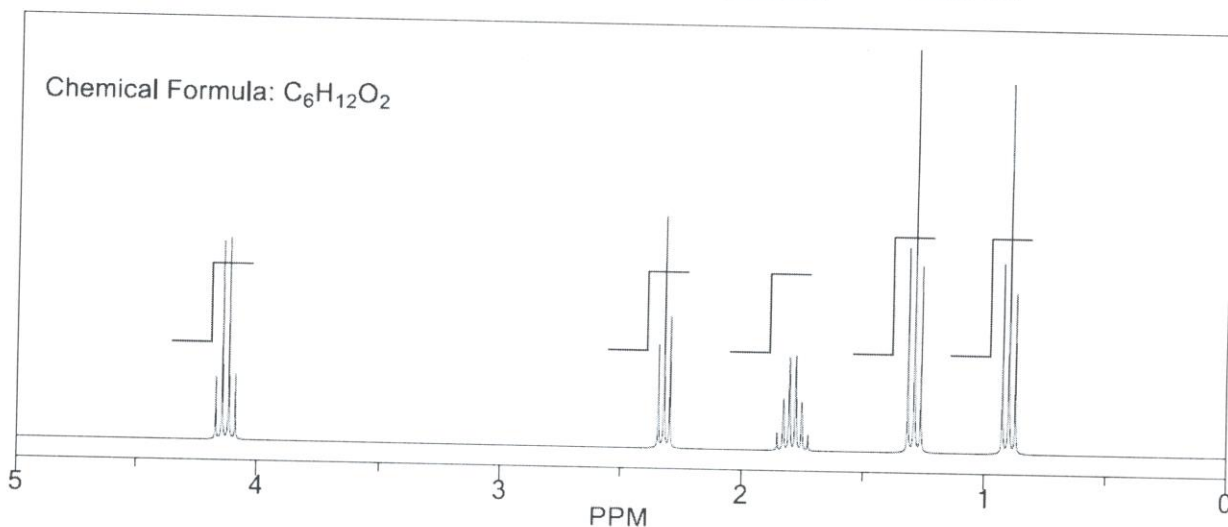
$$DU = \frac{2(7) + 2 + 1 - 9}{2} = \frac{8}{2} = 4 \quad \text{(0.5)} \quad \text{(0.5)}$$

b. Identify **three** key absorptions on the IR spectrum. Write the functional group or bond next to the relevant peak *on the spectrum above*. (3 points) - See above -

10. Indicate **s, d, t, q, or m** (i.e. singlet, doublet, triplet, quartet, multiplet) expected in the 1H NMR spectrum for the protons indicated below. (9 points)



11. A compound $C_6H_{12}O_2$ has the following 1H NMR spectrum. Write down the pertinent comments / ideas about each NMR signal and provide the structure of the unknown.



Signal	δ	Integration	Multiplicity	Comments / ideas
A	4.1	2H	q	- CH_2 next to 3 non-equivalent H's (1) - CH_2 is also next to an O atom (1)
B	2.3	2H	t	- CH_2 next to 2 non-equivalent H's (1) - CH_2 is also next to $C=O$ (1)
C	1.8	2H	m	- CH_2 is next to <u>five</u> non-equivalent H's (1)
D	1.3	3H	t	CH_3 next to 2 non-equivalent H's (1)
E	0.9	3H	t	CH_3 next to 2 non-equivalent H's (1)

(7 points)

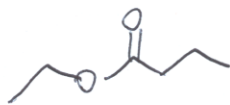
Determine the degree of unsaturation, showing your full calculation clearly. (1 point)

$$DU = \frac{2(6) + 2 - 12}{2} = \frac{2}{2} = \underline{1} \quad (0.5)$$

11. (continued) Structure of unknown:

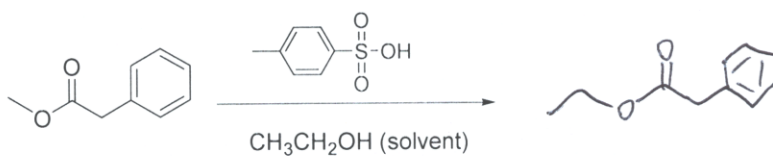
(2 points)

all or nothing



2

12. Draw the structure of the product. (2 points)



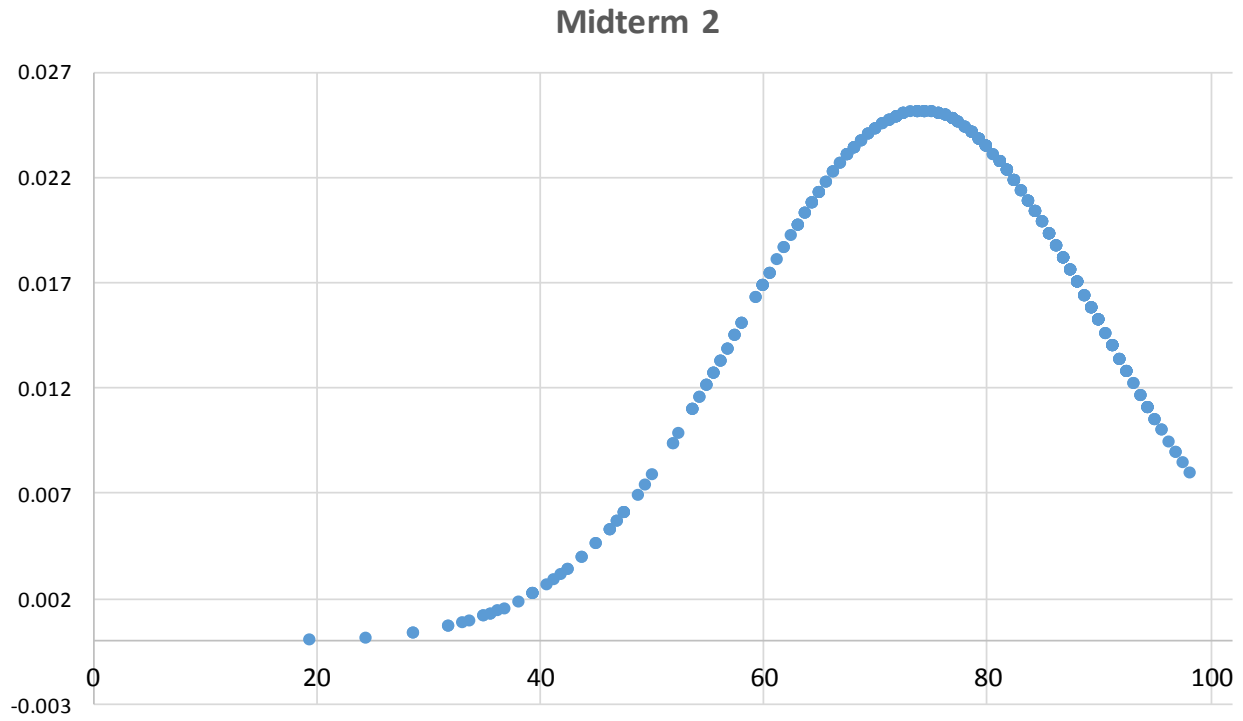
2

=====
End of exam
=====

pK_a Table

Acid	pK _a value (H ₂ O solvent)	Acid	pK _a value (H ₂ O solvent)
HI	-10		9
HBr	-9		9.9
HCl	-8		10.6
	-6.2	H ₂ O	15.7
	-3.8		17
H ₂ SO ₄	-3		20
	-2.6		24
CH ₃ OH ₂ ⁺	-2.2	H ₂	36
H ₃ O ⁺	-1.7	NH ₃	38
HNO ₃	-1.3		50
HF	3.17		51
	4.76		

Statistics:



Average: 59.3 marks out of 80 (or **74.1%**)

Highest: **98%** **Lowest:** **19%**

Regrade request form

If you are requesting a regrade, you must bring this completed form, your midterm, and your student ID to my office no more than five (5) business days (as stated in your Syllabus) after the day midterms were returned to the class.

Reason for request:

Terms of Agreement:

I have thoroughly reviewed the answer key/grading scheme and appendices for this midterm.

I understand that my entire midterm will be regraded and not just the question(s) in dispute.

I understand that my midterm may be remarked in its entirety by the Course Instructor or by another professor in the Department, and not necessarily by the Marking TAs.

I understand that my new score could be higher than, lower than, or equal to the original.

I have read and understood uOttawa Academic Regulation 10.3 on grade revisions.

I understand that I will be referred to the Academic Fraud Committee and the Vice-Dean of Undergraduate Studies if it is suspected that my midterm has been altered in any way.

By signing below, I agree to be bound by the terms and conditions stated herein:

Student Signature

Date

Student name:

Student number: