

Chemistry 2600 Final Exam (Version A)
April 19th, 2008

INSTRUCTIONS

- 1) Read the exam carefully before beginning. There are 9 questions on pages 2 to 10 followed by a periodic table and a blank page for rough work. You are also provided with an NMR Data Sheet (as posted on the class website). **Please ensure that you have a complete exam. If not, let an invigilator know immediately.** All pages must be submitted.
- 2) You are allowed to bring one index card (maximum size 3"x5") into the exam with you as a "cheat sheet". This card must be submitted with your exam.
- 3) You are allowed to bring a ruler and a molecular model kit.
- 4) No electronic devices of any kind (including calculators) are permitted.
- 5) If your work is not legible, it will be given a mark of zero.
- 6) Marks will be deducted for incorrect information added to an otherwise correct answer.
- 7) When drawing molecules, clearly show any relevant stereochemistry. If a mixture of diastereomers is produced, draw both/all of them.
- 8) If you think that you see another student cheating, write a note on your exam paper and raise your hand to show an invigilator so that we can investigate the situation.
- 9) **DO NOT OPEN THE EXAM UNTIL YOU ARE TOLD TO BEGIN.** **Beginning prematurely will result in removal of your exam paper and a mark of 0.**
- 10) You have **3 hours** to complete this exam. Nobody may leave the exam room during the first hour or the last 15 minutes of the exam.

Confidentiality Agreement:

I agree not to discuss (or in any other way divulge) the contents of this exam with or in the presence of any CHEM 2600 student who has not yet written their final exam. *(The last official timeslot ends at 5pm on Monday, April 21st, 2008.)*

Signature: _____

Date: _____

Course: CHEM 2600 (Organic Chemistry II)

Semester: Spring 2008

The University of Lethbridge

Q	Mark
1	/ 8
2	/ 4
3	/ 4
4	/ 3
5	/ 15

Q	Mark
6	/ 15
7	/ 10
8	/ 20
9	/ 1

Total	/ 80
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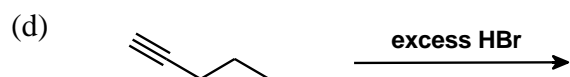
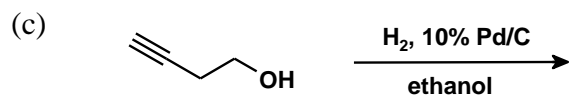
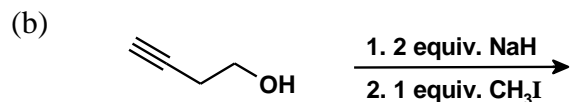
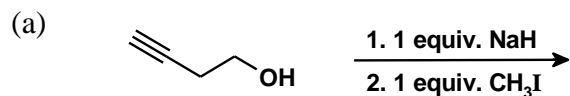
Student Number: _____

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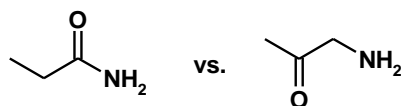
1. **[8 marks]**

- (a) Draw the major organic product of the reaction between 1,3-dipropylbenzene and acetyl chloride (CH_3COCl) in the presence of aluminum chloride.
- (b) With reference to the reaction mechanism, explain the regioselectivity of this reaction.

2. Draw the product of each reaction. [4 marks]

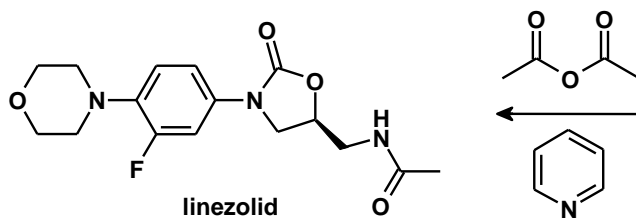
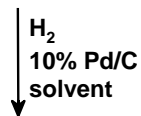
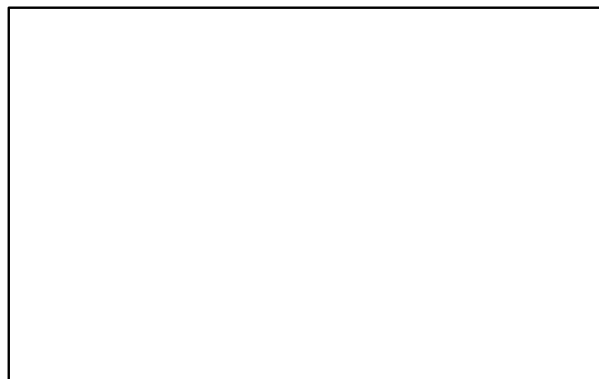
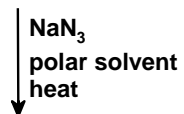
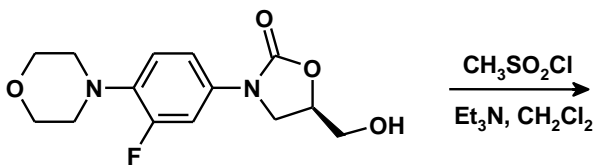


3. Explain how you could use spectroscopy to differentiate between this pair of isomers. Your answer should make reference to at least two types of spectroscopy (IR, ^1H NMR or ^{13}C NMR). *Note that you are not being asked to completely describe each spectrum. You are being asked to point out key differences between spectra of the two isomers. Be specific.* [4 marks]

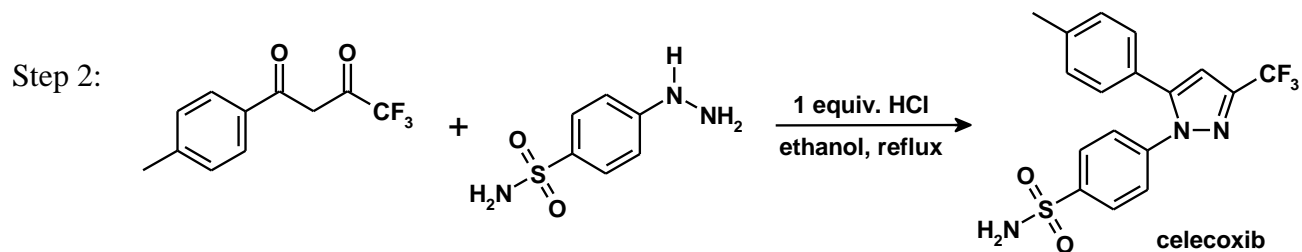
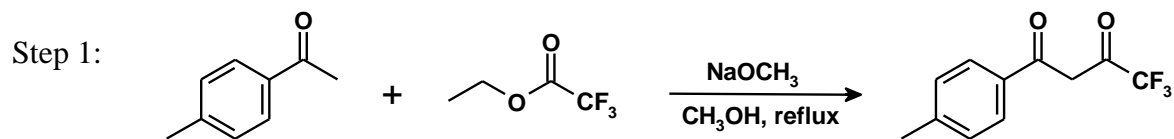


4. Linezolid is an antibacterial drug marketed by Pharmacia as Zyvox[®]. Fill in the blanks in the last few steps of the synthesis of linezolid (shown below). [3 marks]

Some reaction conditions have been simplified for clarity.



5. One synthesis of celecoxib (an anti-inflammatory marketed by Pfizer as Celebrex[®]) is shown below. **[15 marks]**



- (a) Draw the mechanism for Step 1 of this synthesis.

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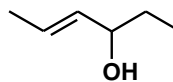
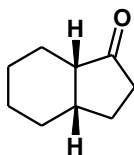
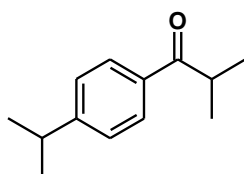
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5. *continued*

(b) Draw the mechanism for Step 2 of this synthesis. *Please abbreviate $C_6H_4SO_2NH_2$ as Ar.*

6. Choose any **three** of the molecules below and propose a synthesis of each. [15 marks]
- Your organic reactants must be stable compounds that contain no more than five carbon atoms. They may be hydrocarbons, alkyl halides or alcohols and may contain C=C or C≡C bonds. You are also allowed to use benzene, bromobenzene or phenol.
 - If you wish to use an organic reactant (including Grignard reagent) that does not meet these requirements, you must show how to make it from starting materials that do.
 - You may use any inorganic reagents, acids, bases, catalysts, etc.
 - Acids, bases, catalysts, etc. do not need to meet the “organic reactant” requirements if the organic part will not be present in the final product.
 - Clearly indicate stereochemistry of reaction products where appropriate. Assume that all stereochemistry shown is relative and that you are to make racemic product.
 - You are not required to show mechanisms for this question.
 - If you work out syntheses for more than three of the molecules, clearly indicate which three you want marked by circling those compounds. Otherwise, I will mark the first three syntheses given.
 - If you run out of space on this page, continue your work on the next page.



Name: _____

Student Number: _____

6. *continued*

7. Compound "A" has the molecular formula C_5H_6 and has a ^{13}C NMR with three signals. It dimerizes readily. When treated with a strong base, anion "A" is generated which gives only one signal on its ^{13}C NMR. **[10 marks]**
- (a) Draw compound "A".
 - (b) Draw anion "A" and explain why it only gives one signal on the NMR.
 - (c) Draw the dimer of "A".
 - (d) Draw the product(s) formed when "A" reacts with 1 equivalent of HCl.
 - (e) Draw the product(s) formed when "A" reacts with 1 equivalent of Br_2 in water.

8. The following two pages contain spectra and the molecular formula for Unknown X. Identify Unknown X based on this information. Use this page to explain your logic. On the NMR spectra themselves, assign as many peaks as you can by numbering the peaks from left to right, drawing Unknown X and labeling each carbon/hydrogen with the appropriate peak number. *You may find it clearer to use numbers for one NMR and letters for the other.* Also, label any important peaks on the IR. **[20 marks]**

9. What was the most interesting and/or useful thing you learned in CHEM 2600? **[1 mark]**

**...AND THAT'S ALL FOR CHEM 2600.
HAVE A GREAT SUMMER!**

DATA SHEET/SCRAP PAPER

Chem 2000 Standard Periodic Table

1																	18
1.0079 H 1											13	14	15	16	17	4.0026 He 2	
6.941 Li 3	9.0122 Be 4											10.811 B 5	12.011 C 6	14.0067 N 7	15.9994 O 8	18.9984 F 9	20.1797 Ne 10
22.9898 Na 11	24.3050 Mg 12	3	4	5	6	7	8	9	10	11	12	26.9815 Al 13	28.0855 Si 14	30.9738 P 15	32.066 S 16	35.4527 Cl 17	39.948 Ar 18
39.0983 K 19	40.078 Ca 20	44.9559 Sc 21	47.88 Ti 22	50.9415 V 23	51.9961 Cr 24	54.9380 Mn 25	55.847 Fe 26	58.9332 Co 27	58.693 Ni 28	63.546 Cu 29	65.39 Zn 30	69.723 Ga 31	72.61 Ge 32	74.9216 As 33	78.96 Se 34	79.904 Br 35	83.80 Kr 36
85.4678 Rb 37	87.62 Sr 38	88.9059 Y 39	91.224 Zr 40	92.9064 Nb 41	95.94 Mo 42	(98) Tc 43	101.07 Ru 44	102.906 Rh 45	106.42 Pd 46	107.868 Ag 47	112.411 Cd 48	114.82 In 49	118.710 Sn 50	121.757 Sb 51	127.60 Te 52	126.905 I 53	131.29 Xe 54
132.905 Cs 55	137.327 Ba 56	La-Lu	178.49 Hf 72	180.948 Ta 73	183.85 W 74	186.207 Re 75	190.2 Os 76	192.22 Ir 77	195.08 Pt 78	196.967 Au 79	200.59 Hg 80	204.383 Tl 81	207.19 Pb 82	208.980 Bi 83	(210) Po 84	(210) At 85	(222) Rn 86
(223) Fr 87	226.025 Ra 88	Ac-Lr	(261) Rf 104	(262) Db 105	(263) Sg 106	(262) Bh 107	(265) Hs 108	(266) Mt 109	(281) Dt 110	(283) Rg 111							
138.906 La 57	140.115 Ce 58	140.908 Pr 59	144.24 Nd 60	(145) Pm 61	150.36 Sm 62	151.965 Eu 63	157.25 Gd 64	158.925 Tb 65	162.50 Dy 66	164.930 Ho 67	167.26 Er 68	168.934 Tm 69	173.04 Yb 70	174.967 Lu 71			
227.028 Ac 89	232.038 Th 90	231.036 Pa 91	238.029 U 92	237.048 Np 93	(240) Pu 94	(243) Am 95	(247) Cm 96	(247) Bk 97	(251) Cf 98	(252) Es 99	(257) Fm 100	(258) Md 101	(259) No 102	(260) Lr 103			

Developed by Prof. R. T. Boeré