Practice Exam Midterm 1A – CHEM 233

Please read before you attempt this exam.

1 – This is a version of the first midterm exam from October of 2016. Since that time, the order in which the material has been delivered has changed. This means that some of the questions on this practice exam are from the actual exam, and some of the questions have been created as practice to replace material not covered yet. It doesn't matter which questions were on the actual exam, and which ones were created for this exam. All questions were created by professors that teach the course.

2 – Completing this practice exam with an answer key near you will give you a false sense of security. Complete the entire exam, then look at the answer key. Note the topics you require more work on (is it acids and bases?, is it electrophilic addition to alkenes?)

3 – A periodic table, model kit and simple calculator will be permitted during the midterm exam. You should power your cell phones off however. This is an older style of exam where students answered both on a Remark Answer Sheet and on the actual exam. **On the upcoming exam, all responses will be on the Remark Answer Sheet only.**

4 – The time limit for this exam was 70 minutes. The time limit for the upcoming exam will be 75 minutes.

5 – A pKa table will not be provided to you on the exam. A pKa table has been on Canvas since the first class. We recommend you memorize the pKa's listed as "Must know – Memorize" for the first midterm exam. Flash cards!

Good luck!

CHEM 233 Teaching Team

CANDIDATE'S NAME: _____
surname (PRINT) **given names (PRINT)**

UBC Student ID NUMBER: _____

CANDIDATE'S SIGNATURE: _____

last initial ↑

Please write your name on each page of the examination.

Indicate your lecture section:

___ Stewart (108 MWF **8 AM**) ___ Stewart (110 MWF **10 AM**) ___ Tanner (103 MWF **3 PM**)

___ Ciufolini (199 TTh **9:30 AM**) ___ Withers (122 TTh **2 PM**)

THE UNIVERSITY OF BRITISH COLUMBIA

CHEMISTRY 233

(ORGANIC CHEMISTRY-BIOLOGICAL SCIENCES)

Midterm 1, October 5, 2016

TIME: 70 MIN—STUDENTS WILL NOT RECEIVE EXTRA TIME TO FILL OUT THE MULTIPLE CHOICE ANSWER SHEET.

This paper consists of **9** pages including this title page, an information sheet and blank sheets for rough work (pages 8-12). **Ensure that you have a complete examination**.
Part 1 will be graded via Remark Software. Part 2 will be graded on this examination.

Each examination candidate must be prepared to produce, upon the request of the invigilator or examiner, his or her UBCcard for identification.

READ AND OBSERVE THE FOLLOWING ADDITIONAL RULES:

• No candidate shall be permitted to enter the examination room after the expiration of 15 min. from the scheduled start time, or to leave during the first 15 min. of the examination.

• Examination candidates are **not permitted to ask questions** of the examiners or invigilators, except in cases of supposed errors or ambiguities in examination questions, illegible or missing material, or the like.

Examination candidates must conduct themselves honestly and in accordance with established rules for a given examination, which will be articulated by the examiner or invigilator prior to the examination commencing. Should dishonest behaviour be observed by the examiner(s) or invigilator(s), **pleas of accident or forgetfulness shall not be received**.

Examination candidates suspected of any of the following, or any other similar practices, may be immediately dismissed from the examination by the examiner/invigilator, and may be subject to disciplinary action:

i. speaking or communicating with other examination candidates, unless otherwise authorized;
ii.purposely exposing written papers to the view of other examination candidates or imaging devices;
iii. purposely viewing the written papers of other examination candidates;
iv. using or having visible at the place of writing any books, papers or other memory aid devices other than those authorized by the examiner(s)
v. using or operating electronic devices including but not limited to telephones, calculators, computers, or similar devices other than those authorized by the examiner(s)—(electronic devices other than those authorized by the examiner(s) must be completely powered down if present at the place of writing).

Examination candidates must not destroy or damage any examination material, must hand in all examination papers, and must not take any examination material from the examination room without permission of the examiner or invigilator.

Examination candidates must follow any additional examination rules or directions communicated by the examiner(s) or invigilator(s).

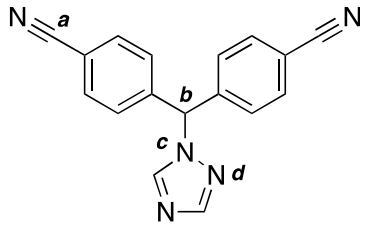
part	question	marks	grader
1		Remark ()	
		/	
2		/	
		/	
	part 2 total	/	

Molecular models may be used during this examination.
Calculators may be used during this examination.

Section 1: Multiple choice. Questions 1-26 must be answered on the Remark Multiple Choice answer form by shading the appropriate circle with **pencil or pen**. Remark responses will be used to calculate your grade. Please indicate your answers on this examination paper in the event your Remark form is lost.

Note that ***more than one letter*** could be entered as an answer to a multiple choice question. Questions are not equally weighted in marks; it is ***not 1 mark per answer***.

Questions 1 to 6. Consider the molecule (*letrozole, a cancer medication)* to the right. Take note of the fact that specific atoms in this structure have been labelled ***a*** through ***d***.



1) Indicate the hybridization of the carbon atom labeled ***a***:

(**A**) s (**B**) p (**C**) sp (**D**) sp^2 (**E**) sp^3 (**F**) σ (sigma) (**G**) π (pi)

2) Indicate the hybridization of the carbon atom labeled ***b***:

(**A**) s (**B**) p (**C**) sp (**D**) sp^2 (**E**) sp^3 (**F**) σ (sigma) (**G**) π (pi)

3) Indicate the hybridization of the nitrogen atom labeled ***c***:

(**A**) s (**B**) p (**C**) sp (**D**) sp^2 (**E**) sp^3 (**F**) σ (sigma) (**G**) π (pi)

4) The non-bonded electron pairs on the nitrogen atom labeled ***d*** reside in a _____ orbital.

(**A**) s (**B**) p (**C**) sp (**D**) sp^2 (**E**) sp^3 (**F**) σ (sigma) (**G**) π (pi)

5. How many hydrogen atoms are in one molecule of letrozole?

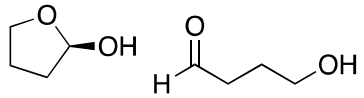
(**A**) 8 (**B**) 9 (**C**) 10 (**D**) 11 (**E**) 12 (**F**) 13 (**G**) 14

6. Is letrozole a chiral molecule?

(**A**) yes it is chiral (**B**) no it is not chiral

Questions 7 to 12. For each of the pairs of structures below, indicate whether these pairs are:
A-identical compounds; **B**-constitutional isomers; **C**-diastereomers; **D**-enantiomers or **E**-not isomers.
You can use each letter more than once in this section, and you do not need to use them all.

7)



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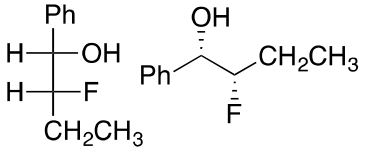

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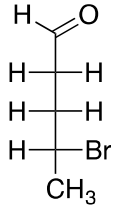
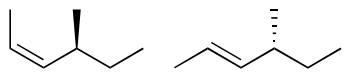


(*S*)-4-bromopentanal

10)



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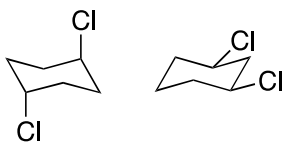

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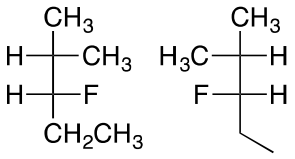
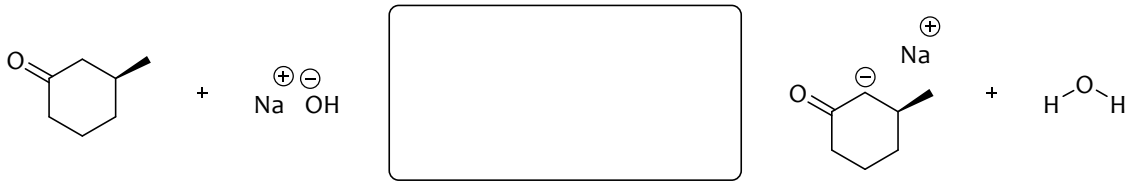
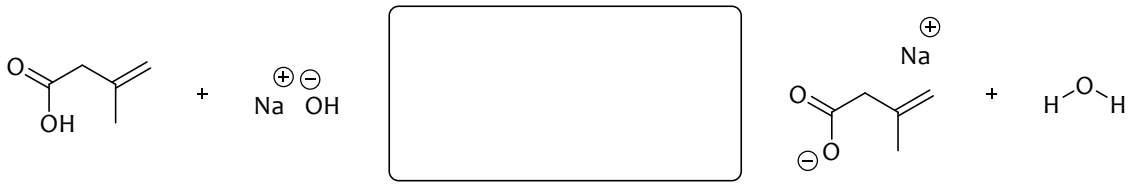


Questions 13-18. Select the letter (**A**, **B**, **C**, **D**) that corresponds to the arrows that *best* describes the relationship between the structures on the left and right sides of the chemical equations shown below.

A **B** **C** **D**

13) 

14) 

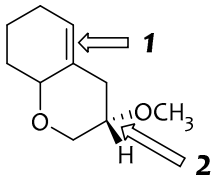
15) 

16) 

17) 

18) 

Questions 19-21. Consider the molecule below when answering these questions.



19) The configuration of the alkene indicated by ***1*** is:

A: *R* **B**: *S*
C: *cis* **D**: *trans*
E: *E* **F**: *Z*
G: (+)- **H**: (-)-

20) The configuration of chirality center ***2*** is:

A: *R* **B**: *S*
C: *cis* **D**: *trans*
E: *E* **F**: *Z*
G: (+)- **H**: (-)-

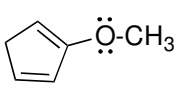
21) The functional group that includes carbon ***2*** is a/an:

A: acetal **B**: ketal
C: 3° alcohol **D**: aldehyde
E: 2° alcohol **F**: ester
G: ether **H**: ketone

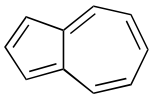
1°: primary; 2° secondary; 3° tertiary

Question 22. Consider the series ***A***-***G*** on the right.

Indicate the species which are aromatic. More than one compound may be selected. Note that incorrect selections will be subtracted from correct to a minimum of zero for question 22.



A



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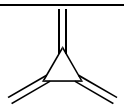

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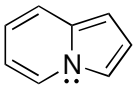
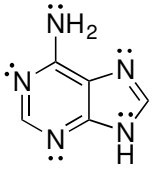
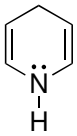


D



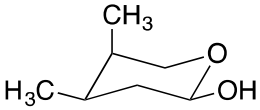
E



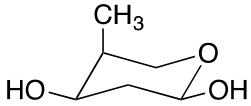
F

Question 23. Rank the compounds 1-3 (below) in order of *increasing* boiling point (lowest to highest):

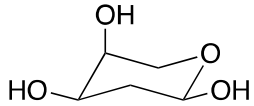
1



2



3



A) 1<2<3 **D**) 3<2<1

B) 1<3<2 **E**) 2<3<1

C) 3<1<2 **F**) 2<1<3

Questions 24 to 26. Is each of the following phrases (A) true or (B) false?

24. In a sample of an organic compound, there are more molecules present as a major resonance structure than molecules present as a minor resonance structure.

25. Meso compounds are optically active.

26. In a pure sample of 5-fluoro-5-methyl-2-hexanone, there are hydrogen bond interactions between the molecules.

This is the end of the multiple choice portion of the examination. Please make sure you have bubbled in your intended answers on the Answer Sheet which accompanies this examination.

Section 2. Short answer questions. Please write your answers in the designated space. Please note that in some cases it is better for you to work out your answer on practice paper and copy a neat version to the examination paper.

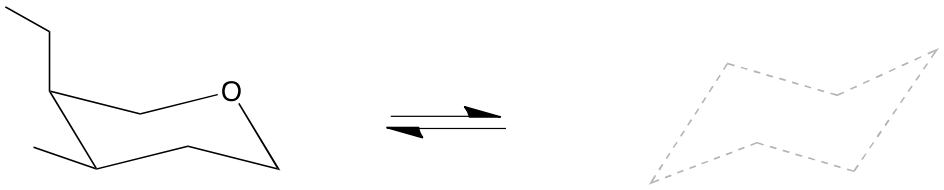
*****Messy and/or incoherent answers that are difficult to read or interpret may receive reduced or zero credit.*****

2-1) (4 marks) Given the description and molecular formulas for the indicated species, draw **Lewis structures** with all lone pairs and formal charges clearly shown. If appropriate, provide only the most significant resonance contributor. Note: line-bond or other representations will not receive full marks!

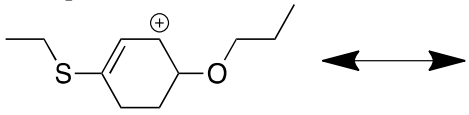
a cyclic chiral compound with the molecular formula $C_4H_8O_2$ and *R* configuration

conjugate acid of ($CH_3COCH_2^-$)

2-2) (3 marks) Draw the structure on the left on the template on the right, after a ring-flip.

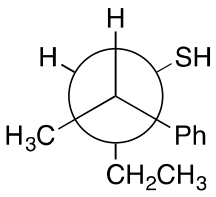


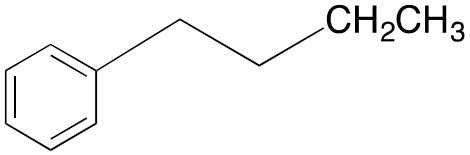
2-3) (6 marks) Draw the *contributing resonance structures* that stabilize the following cation. Be sure to indicate electron movement using curved arrows between each structure in your sequence. Include all lone pairs of electrons and formal charges.



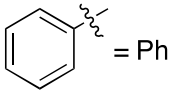
Circle the major resonance contributor and justify your selection with a short phrase.

2-4) (3 marks) Using the supplied template, provide a *zig-zag projection* from the Newman projection of this compound:

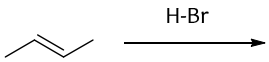


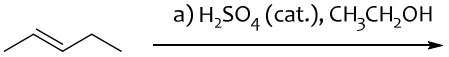


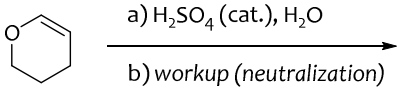
Note:

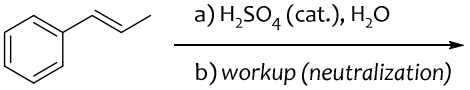


2-5) (4 marks) Predict the product for each of the following reactions. Clearly draw each stereoisomer if applicablel. A mechanism is not required for these questions, just the major product(s).

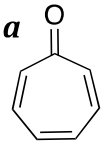


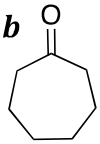




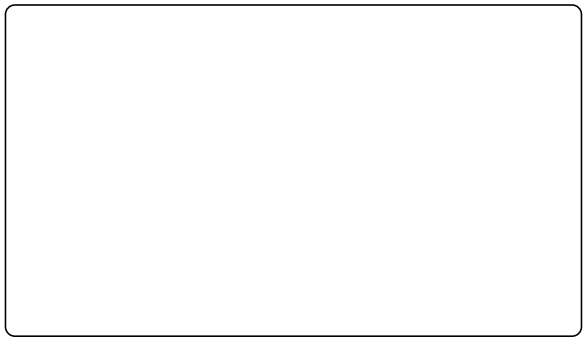


2-6) (2 marks) Experimental evidence has shown that compound ***a*** is much more polar than compound ***b***. Provide a brief rationale for this observation.

a 

b 

2-7) (3 marks) Provide the structure that results from the transformation shown with the curved arrows. Be sure to include formal charges if they are required.



reaction intermediate following the transformation

end of exam questions

Periodic Table of the Elements

1 H																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 Db	106 Sg	107 Bh	108 Hs	109 Mt	110	111	112		114		116		118

58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr