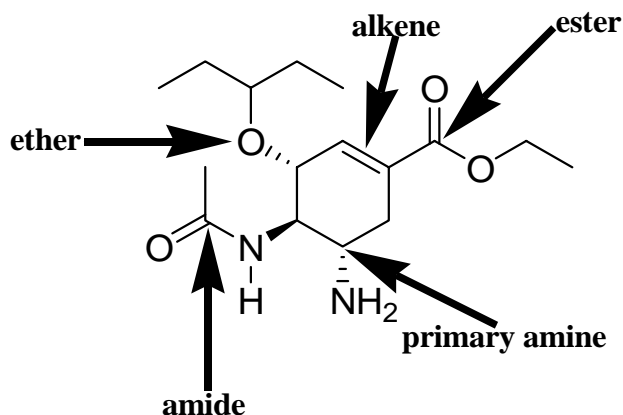


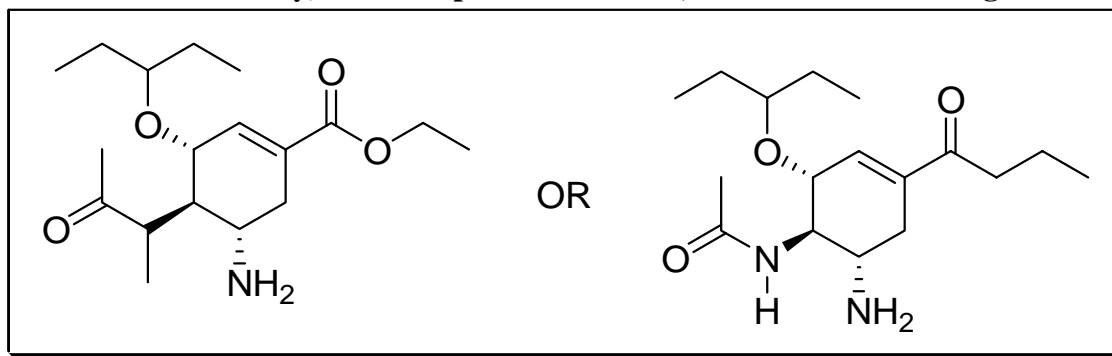
Chemistry 11 Fall 2008 Examination #3 ANSWER KEY

1. (52 pts. total) *Oseltamivir* (sold under the trade name *Tamiflu*[®]) is a prescription antiviral drug that is used in the treatment of both *Influenzavirus A* and *Influenzavirus B*.



Answer the questions below relating to this drug.

- A. (5 pts.) Label ALL the functional groups present in *Oseltamivir* in the structure above. If any alcohols or amines are present, determine if they are primary, secondary, or tertiary. **See above**
- B. (2 pts.) Add, subtract, or otherwise change NO MORE THAN 3 ATOMS in *Oseltamivir* to create a new molecule that contains one more ketone than *Oseltamivir* has. (You may remove other functional groups if necessary). **Several possibilities here; consider the following:**



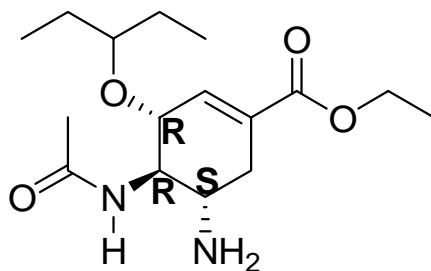
- C. (2 pts.) Circle one answer in each row so that your entire answer best describes the O=C-N geometry and bond angle in *Oseltamivir*:

| | | | | |
|--------|-----|------------------------|-------------|-------------|
| Linear | | Trigonal Planar | | Tetrahedral |
| 60° | 90° | 109.5° | 120° | 180° |

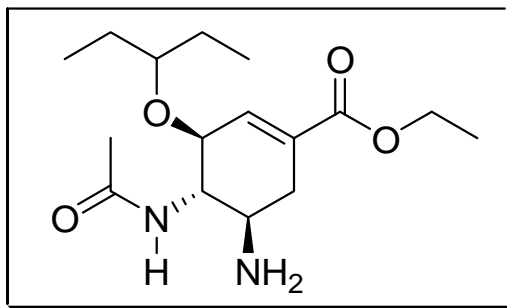
- D. (4 pts.) The molecular formula of *Oseltamivir* is **C₁₆H₂₈N₂O₄**.
- E. (4 pts.) Place a check mark in the box next to all the words that describe *Oseltamivir*: **Chiral and Optically Active**

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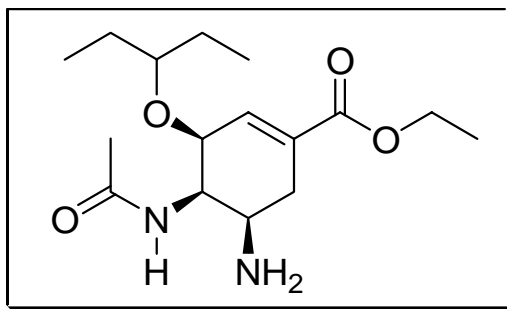
- F. (6 pts.) On the structure below, clearly label all the stereocenters (if any) present in *Oseltamivir* as either *R* or *S*. See below:



- G. (4 pts.) Draw an enantiomer of *Oseltamivir*. If this is NOT possible, write “not possible”, then explain why using no more than 20 words.

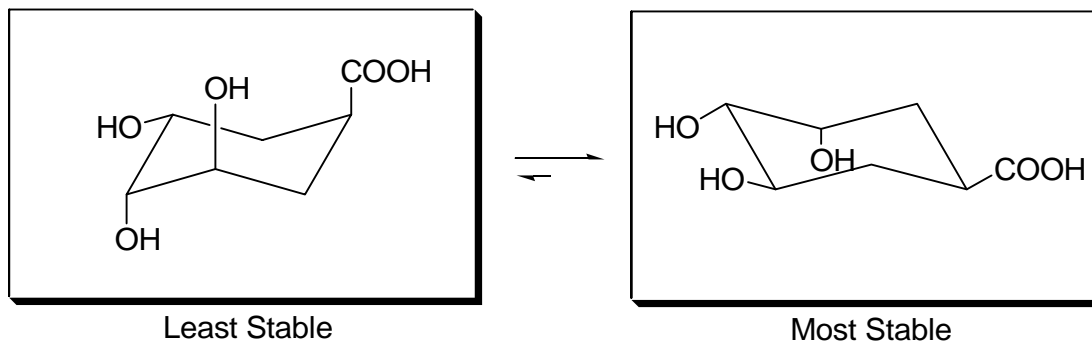


- H. (4 pts.) Draw a diastereomer of *Oseltamivir*. If this is NOT possible, write “not possible”, then explain why using no more than 20 words. **Several possible answers here; consider the example shown:**

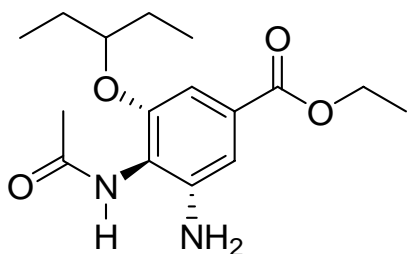


- I. (8 pts.) *Oseltamivir* is synthesized starting from shikimic acid, which can be partially hydrogenated to form the compound shown below. Draw the most stable and least stable conformations of the molecule shown:

Chemistry 11 Fall 2008 Examination #3 ANSWER KEY

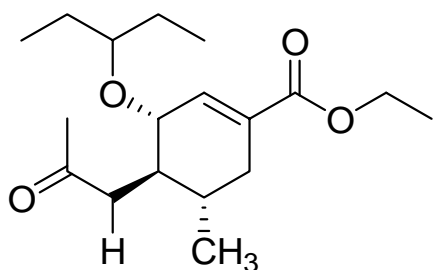


- J. (4 pts.) Recall our discussion of intermolecular forces in section 2. List and briefly describe ALL the intermolecular forces that would need to be overcome in order for *Oseltamivir* to boil. **London Dispersion forces, Dipole-dipole interactions, and Hydrogen bonding**
- K. (8 pts. total; 4 pts. each) For each of the following molecules, circle whether you would expect it to have a HIGHER or LOWER boiling point than *Oseltamivir*. Briefly explain your answer.



would have a (CIRCLE ONE) higher lower boiling point than *Oseltamivir*.

EXPLANATION: **The aromatic nature of this molecule due to the benzene ring makes it more stable.**



would have a (CIRCLE ONE) higher lower boiling point than *Oseltamivir*.

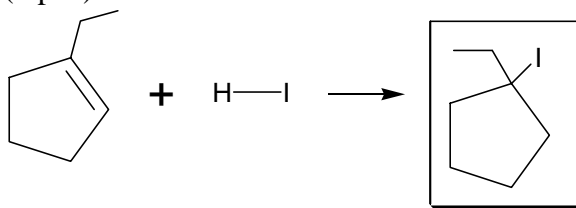
EXPLANATION: **No hydrogen bonding present.**

- L. (1 pt.) What is the maximum number of stereoisomers possible for *Oseltamivir*? $2^3 =$ **maximum stereoisomers**

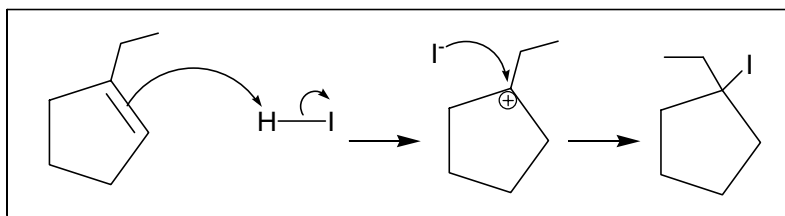
Chemistry 11 Fall 2008 Examination #3 ANSWER KEY

2. (14 pts. total) **REACTIONS AND MECHANISMS!** Predict the MAJOR product for the reactions listed below, and give the appropriate curved arrow notation where requested. Write NR if no reaction occurs.

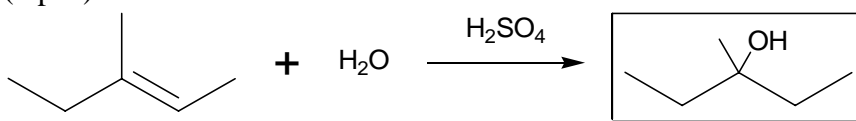
A. (4 pts.)



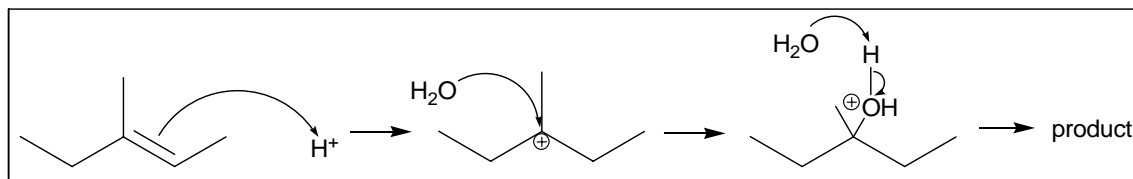
mechanism:



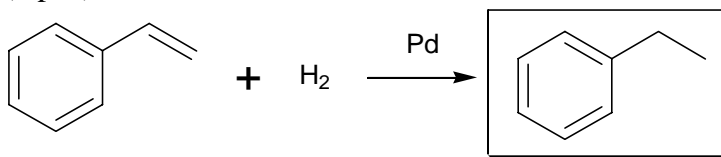
B. (4 pts.)



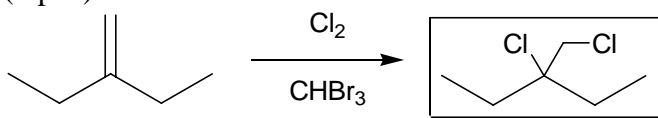
mechanism:



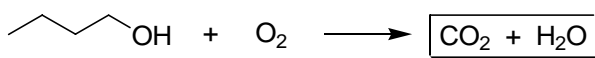
C. (2 pts.)



D. (2 pts.)



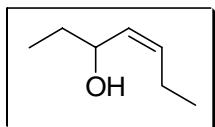
E. (2 pts.)



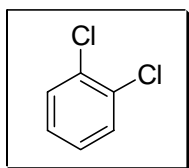
Chemistry 11 Fall 2008 Examination #3 ANSWER KEY

3. (18 pts. total; 3 pts. each) **NOMENCLATURE!** Use the appropriate IUPAC notation to name/draw each of the organic structures below:

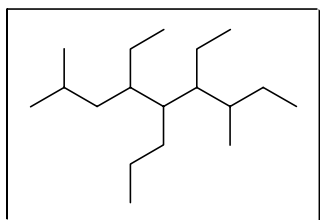
A. *cis*-4-hepten-3-ol



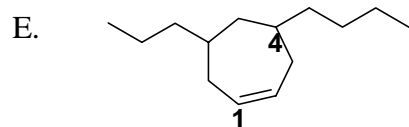
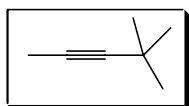
B. *o*-dichlorobenzene



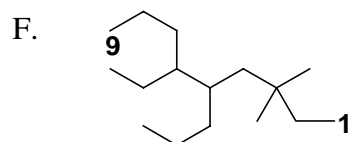
C. 4,6-diethyl-2,7-dimethyl-5-propylnonane



D. 4,4-dimethyl-2-pentyne



4-butyl-6-propylcycloheptene

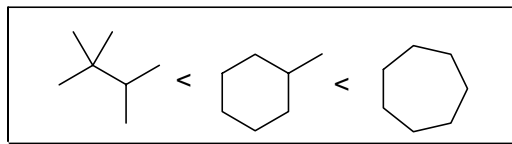


6-ethyl-3,3-dimethyl-5-propylnonane

Chemistry 11 Fall 2008 Examination #3 ANSWER KEY

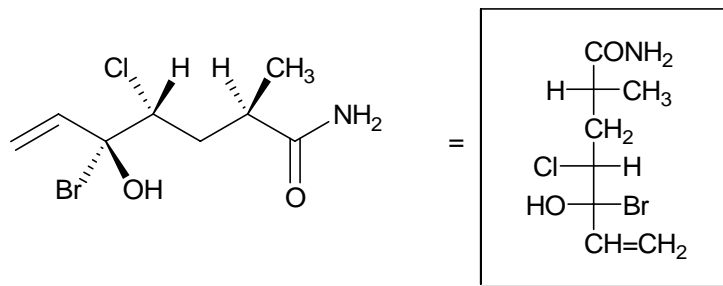
4. (16 pts. total) **SHORT ANSWERS!** Respond to each of the questions below.

A. (4 pts.) Arrange the following compounds in order of expected increasing boiling points, and briefly explain your ordering.



The boiling point of the branched alkane is the lowest because it is more compact, which reduces the amount of contact between the molecules. Cycloalkanes have higher boiling points than continuous-chain alkanes due to restricted carbon-carbon bond rotation, making the structures rigid.

B. (6 pts.) Draw a Fischer projection on the right to correspond to the given structure on the left.



C. (6 pts.) Consider each of the drugs listed below. Describe whether each is sold as a single enantiomer or a racemic mixture. How does consumption of each drug affect the human body?

- 1) Thalidomide – **Because the (S)-enantiomer is known to be teratogenic, Thalidomide is sold as the (R)-enantiomer and is useful in the treatment of leprosy and possibly AIDS.**
- 2) Ibuprofen – **Sold as a racemic mixture; the (R)-enantiomer is biologically inactive in our bodies, while the (S)-enantiomer is active as a pain and fever reliever.**
- 3) Captopril – **Sold as the (S)-enantiomer, this drug is effective for the treatment of high blood pressure and congestive heart failure.**