Instructions: This is a multiple choice / short answer practice exam. For the multiple-choice questions, there may be more than one correct answer. If so, then circle as many answers as you believe to be correct. You will get 3 pts for each correct response and 1 for each wrong response. If there is a choice of “other”, and you choose “other”, you MUST provide a correct alternative answer on the line provided in order to get the question right. Only choose “other” if there are no correct answers present. The short answer questions are worth 5 to 20 points each. Where I have asked for you to draw a structure or mechanism, be very precise with your arrows and such…don’t make me guess as to what you meant.

You may only use a pen or pencil, big eraser, and a molecular model set to take this exam. You have 60 minutes to complete this exam. Your signature above indicates that you have taken this exam in accordance with the University Honor Code. Good luck!

![Isoleucine Structure](image)

1) How many stereogenic centers does isoleucine have?
   a. 1
   b. 2
   c. 3
   d. 4
   e. other ________________________________

2) How many potential stereoisomers does isoleucine have?
   a. 2
   b. 3
   c. 4
   d. 6
   e. other ________________________________
3) (20) With great precision, draw each of the stereoisomers for isoleucine using Fisher projections.

\[
\begin{align*}
A & : \text{H}_2\text{N} - \text{S} - \text{H} \\
 & : \text{H} - \text{R} - \text{Me} \\
 & : \text{R} - \text{Et} \\
C & : \text{H} - \text{R} - \text{Me} \\
 & : \text{H} - \text{NH}_2 \\
B & : \text{H} - \text{R} - \text{NH}_2 \\
 & : \text{R} - \text{Me} - \text{S} \\
 & : \text{S} - \text{Et} \\
D & : \text{H} - \text{S} - \text{H} \\
 & : \text{H} - \text{H} \\
 & : \text{H} - \text{H} \\
\end{align*}
\]

4) (16) For each stereoisomer drawn above in problem 4, label each stereogenic center as R or S.

See Above…

5) (8) Detail the stereochemical relationships between each of the isomers drawn above in question 4 (ie, enantiomer, diastereomer, meso, etc.).

A,B are enantiomers; C,D are enantiomers…all other combinations are diastereomers

6) The “degree of unsaturation” of a compound indicates…
   a. …the number of double bonds in the compound.
   b. …the number of rings in a compound.
   c. …the number of rings and pi bonds in a compound
d. …the number of halogens in a molecule
   e. other _______________________________________________________

7) An organic compound has a molecular formula of C_{20}H_{40}O. What is its degree of unsaturation?
   a. 0.5
   b. 1
   c. 1.5
   d. 2
   e. other _______________________________________________________

2
8) Phytol (above) is the long side-chain part of chlorophyll-A. How many stereogenic centers are in phytol?
   a. 1
   b. 2
   c. 3
   d. 4
   e. other

9) The isomer of phytol as shown in problem 9 is…
   a. …the 2E isomer
   b. …the 2Z isomer
   c. …the 7R,11R,15R isomer
   d. …the 2S,6S,10S isomer
   e. other

10) (8) With great precision, using normal line structure conventions, draw the 2Z,7S,11R isomer of phytol.

11) Menthol (above) is one of the typical flavor ingredients added to tobacco. How many stereogenic centers are in the isomer of menthol shown above?
   a. 1
   b. 2
   c. 3
   d. 4
   e. other
12) (12) Circle and label the stereogenic centers in menthol (above) as R or S.

13) (5) Provide a proper IUPAC name for the isomer of menthol above.

(1S,2R,5S)-2-(1-methylethyl)-5-methylcyclohexanol

14) (5) Draw (with great precision) the enantiomer of the menthol isomer in question 11.

15) (5) Draw (with great precision) a diastereomer of the menthol isomer in question 11.

...many answers are possible

16) (5) Draw (with great precision) the meso isomer of the menthol isomer in question 11.

...no meso isomer, as there is no plane of symmetry.

17) (10) Draw the menthol isomer in question 11 as a chair. Then draw the other possible conformer. Circle the most stable (lowest energy) conformer.
18) (6) Draw the E and Z isomers of 2-pentene.

\[ Z \]

\[ E \]

19) (15) Briefly explain which isomer of 2-pentene is preferred (lowest energy).

**E is preferred...less steric hinderence**

20) 2,3-dichlorobutane...
   a. ...is a chiral molecule
   b. ...is not a chiral molecule
   c. ...has 2 stereogenic centers
   d. ...has 4 unique stereoisomers
   e. other ___________________________________________________________

21) (15) Using a Newman diagrams, briefly explain whether the R,R  S,S  R,S or S,R provide the most stable conformer of 2,3-dichlorobutane. (in terms of relative size, H is like a golf ball, methyl is like a softball and Cl is like a big beach ball).

Lowest E...only 2 gauche interactions each (these compounds are identical)

Higher E...3 gauche interactions each
22) Compounds A and B (above) are 2 of 5 possible structural isomers of compounds with the molecular formula C₃H₆BrOH.
   a. (6) draw the remaining three structural isomers above “C”, “D” and “E”.
   b. (6) Identify the stereogenic centers on each molecule (A-E) by circling the chiral carbons.
   c. (8) For compounds C, D and E, draw the R and S versions of the compound(s) with chiral centers.