DO NOT OPEN THE EXAM UNTIL INSTRUCTED

Exam 2

Directions:

Please check the exam to be sure there are 8 non-blank pages including the title page. Read all questions and directions carefully before entering answers. A separate packet containing useful tables, a periodic chart and the multiple choice questions will be provided.

GOOD LUCK
I. (30) In the space provided place the letter of the response which best answers or completes the statement.

C  1.

E  2.

D  3.

A  4.

E  5.

A  6.

D  7.

D  8.

A  9.

B  10.

Total _____
II. (15) Carefully draw both chair conformations of cis-1-chloro-3-ethylcyclohexane.

- You must include all hydrogens on the rings.
- You must label all positions as equatorial (e) or axial (a).
- You must circle the most stable chair conformation.

![Diagram of chair conformations of cis-1-chloro-3-ethylcyclohexane]

• The most stable chair conformation is circled.
III. (20) Provide structures, names or answers as requested:

(8) Provide IUPAC names including stereochemical designations where appropriate for the following molecules.

\[ \text{trans-1,3-dibromocyclohexane} \]

(3R)-3-bromo-1-chlorobutane

(12) For each of the following pairs of structures, indicate whether the two compounds are identical, enantiomers or diastereomers:

Identical – no stereocenter

Enantiomers

Diastereomers

(2) Circle the following molecule that would be considered a monoterpenie:
IV. (15) Define or describe using complete sentences and/or drawings any three of the following five terms:

**Chiral** - A chiral object (molecules included) is one that is not superimpossable on its mirror image. Examples include molecules with a single stereocenter, your hands, your body, etc. – The list is almost endless.

**Enantiomer** A stereoisomer (same connectivity – different arrangement in space) that is not superimpossable on its mirror image. A chiral molecule that frequently contains one or more stereocenters (a carbon with four different groups attached). They have identical physical properties (bp, mp, etc.) except for the rotation of plane polarized light.

**Diastereomer** A pair of stereoisomers (same connectivity – different arrangement in space) that are not mirror images of each other. Examples include cis/trans isomers and molecules with two or more stereocenters that are not mirror images of each other. Typically diastereomers have different physical properties that allow them to be separated from one another.

**Dextrorotatory** Optically active materials will rotate plane polarized light. If the light rotates clockwise as viewed looking through the sample towards the source, it is the dextrorotatory enantiomer.

**1,3-diaxial interaction** 1,3 diaxial interactions occur in cyclohexane chair conformations when substituents are oriented along the rotational axis. Large substituents will tend to prefer equatorial positions to minimize 1,3-diaxial interactions.
V. (20) Answer the questions on any two of the following three pages. Write ‘OMIT” through the page you wish omitted. Your answers must be clear and complete in order to receive complete credit. A well drawn picture is frequently worth a thousand words.

1. The two isomers of carbone [systematic name: 2-methyl-5-(1-methylethenyl)-2-cyclohexenone] are drawn below. Which is R and which is S?

\[\text{(+)-carvone (caraway seeds)}\]

\[\text{(-)-carvone (spearmint)}\]
2. For each of the following cyclohexane derivatives,
• Indicate whether the molecule is a cis or trans isomer;
• Whether it is in its most stable chair conformation;
• If it is not the most stable chair conformation, draw the most stable conformation.

Using the data in Table 4.3, calculate \( \Delta G^\circ \) for the ring flip to the other conformation for 1-chloro-2-methylcyclohexane (‘reactant’) above.
Axial to equatorial Cl \(-0.52\) kcal/mole
Axial to equatorial CH\(_3\) \(-1.70\) kcal/mole

\( \Delta G^\circ = -2.22\) kcal/mole
3. Carefully draw Fischer projections for all four stereoisomers of 2,3-dibromopentane. You must indicate R,S absolute configuration for all stereocenters.