INSTRUCTIONS —

This examination has two parts. The first part is in multiple choice format; the questions are in this Exam Booklet and the answers should be placed on the "Test Scoring Answer Sheet" which must be turned in and will be machine graded.

The second part requires your responding to questions in this Exam Booklet by writing answers into the spaces provided. The Exam Booklet must be handed in and will be returned to you with a grade.

On the Test Scoring Answer Sheet, using a soft pencil, enter the following data (in the appropriate places): your name, instructor's name, your OSC Student Number or Social Security number, course number (30022101) and the test number (03); darken the appropriate bubbles under the entries (if you are using your student number which begins with a letter, leave the bubbles under the letter blank, but darken the bubbles under the numbers), making dark black marks which fill the bubbles.

You may use a set of molecular models and the periodic table (last page) provided, but no other aids, during the exam.

Answer all questions. The questions on Part I are worth 4 points each.

You have 50 minutes. Good luck!
1. Provide the IUPAC name for the compound shown to the right.

\[ \text{H}_3\text{C}--\text{CCl}_2--\text{Cl}_2--\text{CH}_2--\text{C}≡\text{C}--\text{CH}_3 \]

(a) 2,2,3,3-tetrachloro-5-heptyne, (b) 2,2,3,3-tetrachloro-5-heptene,
(c) 2,2,3,3-tetrachloro-5-octyne, (d) 2,3-tetrachloro-5-heptyne,
(e) 5,5,6,6-tetrachloro-2-heptyne, (f) None of the previous answers is correct.

2. Select the structure(s) of the intermediate(s) that is(are) formed when (Z)-2-butene reacts with bromine.

(a) I only, (b) II only, (c) III only, (d) I & II, (e) I, II & III, (f) None of the previous answers is correct.

3. Select the major organic product of the following reaction.

Note: The N-bromosuccinimide provides a low concentration of bromine.

(e) None of the previous answers is correct

4. Select the major organic product of the following reaction.

(e) None of the previous answers is correct
5. What is (are) the principal organic product(s) of the following reaction?

\[ \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH} \]

(a) CH₃CH₂CH₂CH₂OH
(b) R-isomer only
(c) S-isomer only
(d) unequal amounts of R & S isomers
(e) racemic mixture of R & S isomers

6. Select the principal product of the following reaction sequence.

\[ \text{H}_3\text{C} \text{-CH}_{2}-\text{C}==\text{CH} \]

1. BH₃
2. H₂O₂, KOH (pH=8) → major product

(a) H₃C-CH₂-C-CH₃
(b) (CH₃)₂CH-C-CH₃
(c) H₃C-CH₂-C=CH₂
(d) H₃C-CH₂-CH=CH₂
(e) H₃C-CH₂-CH₂-CH

7. Select the appropriate reagents to carry out the indicated reaction.

(a) H₂, Lindlar catalyst,
(b) H₂, Pt,
(c) H₂O, H₂SO₄, HgSO₄,
(d) Li, NH₃,
(e) NaNH₂ in NH₃

8. Which of the alkyl chlorides below is likely to be most successful in the following reaction, where R is an alkyl group: CH₃C=CHR + Na⁺ + Cl⁻ → CH₃C=C-R + Na⁺Cl⁻

(a) CH₃CH₂Cl,  (b) (CH₃)₂CCl,  (c) (CH₃)₂CHCl
(d) Bogus question, dude! Like, none of these compounds will react this way.

9. A pair of stereoisomers that are not enantiomers are

(a) constitutional isomers.  (b) meso structures.  (c) diastereomers.  (d) conformational isomers.  (e) Another bogus question, dude! Like, all stereoisomers are enantiomers.

10. If a chiral substance that has just one chiral center is dextrorotatory the chiral center is

(a) R,  (b) S,  (c) E,  (d) Z,
(e) Actually it is impossible to tell whether the chiral center is R or S based only on the rotational direction of the optical activity.
11. Select the statement that best describes the relationship between the two structures shown to the right.

They are
(a) constitutional isomers. (b) enantiomers. (c) diastereomers. (d) the same molecule and not meso structures. (e) the same molecule and are meso structures.

12. Select the statement that best describes the relationship between the two structures shown to the right.

They are
(a) constitutional isomers. (b) enantiomers. (c) diastereomers. (d) the same molecule and not meso structures. (e) the same molecule and are meso structures.

14. Select the answer that correctly indicates the R/S configuration around the chiral centers in the molecule to the right.

(a) 1-R, 2-R, (b) 1-R, 2-S, (c) 1-S, 2-R, (d) 1-S, 2-S.

15. Which of the following is not true of enantiomers?

(a) They have the same boiling point. (b) They have the same melting point. (c) They have the same specific rotation. (d) They have the same density. (e) They have the same chemical reactivity toward achiral reagents.

16. Which of the following molecules is chiral?

(a) H_3C-CH_3, (b) Cl-C≡H, (c) Br, (d) H.

17. Which of the molecules in question #16 is a meso structure?

18. Which of the following is not a reactive intermediate in the free radical chlorination of methane?

(a) H•, (b) H_3C•, (c) Cl•, (d) Bogus question. All of them are intermediates.
19. Select the two products that form in the following reaction.

(a) I&II, (b) I&III, (c) I&IV, (d) II&III, (e) II&IV, (f) III&IV

20. Which of the following alcohols will be most reactive toward HBr in terms of converting the alcohol to an alkyl bromide?

(a) \( \text{CH}_3\text{CHCH}_2\text{CH}_3 \)  (b) \( \text{HOCH}_2\text{CH}_2\text{CH}_2\text{CH}_3 \)  (c) \( \text{H}_3\text{C} - \text{C} = \text{CH}_3 \)

(d) These alcohols would be essentially equally reactive.
Mechanism.
(a) Show the mechanism for the following reaction.
> Be certain to clearly show the configurations around the chiral carbon(s) in the product(s).
> Be certain to show all intermediates and their stereo (3-dimensional) structure(s).
> Be certain to show direction(s) of approach of reacting species if it has stereochemical consequences. For example, if an approach from one direction leads to one stereoisomer and approach from a different direction leads to a different stereoisomer, show this.

(b) Is the product, or mixture of products taken as a whole, of this reaction optically active?
2. **Synthesis.**
Outline syntheses which would produce each of the following compounds in good yield. [Note: In outlining a synthesis you should show explicitly what compounds you are using and any special conditions. You need not balance equations or show mechanisms; doing so correctly will gain you no additional credit, doing so incorrectly will cost you.]

(a) You must start each synthesis with cyclopentene, and may use any other materials you need to carry it out. More than one step may be required.

(i) 3-bromocyclopentene

![3-bromocyclopentene](image)

3-Bromocyclopentene is a chiral molecule. Will just one enantiomer form, or will unequal amounts of the two enantiomers form, or will the product be racemic?

(ii) 3-(3-cyclopentenyl)cyclopentene

![3-(3-cyclopentenyl)cyclopentene](image)