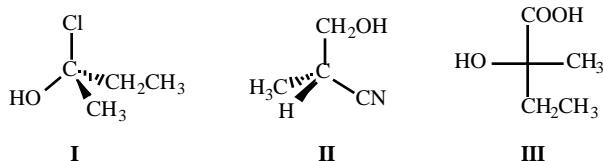


Part I. Multiple choice. (4 points each.) Choose the one best answer and mark your answer on the ScanTron sheet.

1. Which of the compounds below is chiral?

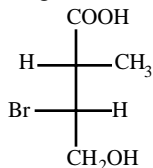
- a) *trans*-1,2-dibromocyclohexane
- b) *cis*-1,2-dibromocyclohexane
- c) *cis*-1,4-dibromocyclohexane
- d) *trans*-1,4-dibromocyclohexane
- e) all of these

2. Which of the compounds below has an R configuration?



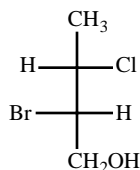
- a) I
- b) II
- c) III
- d) I and II
- e) I, II, and III

3. What is the configuration of the compound shown?

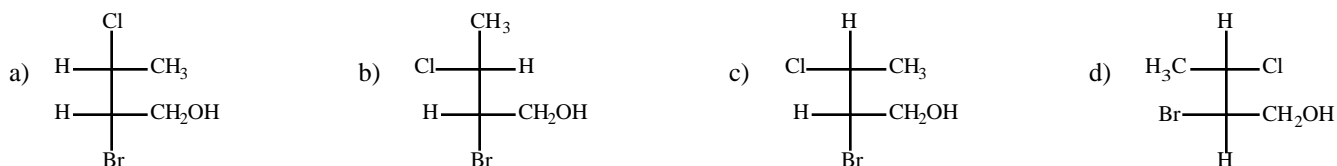


- a) 2R, 3R
- b) 2R, 3S
- c) 2S, 3R
- d) 2S, 3S

4. Consider the molecule below:

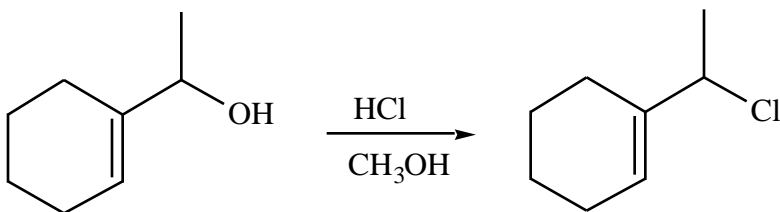


Which structure is an enantiomer of this molecule?

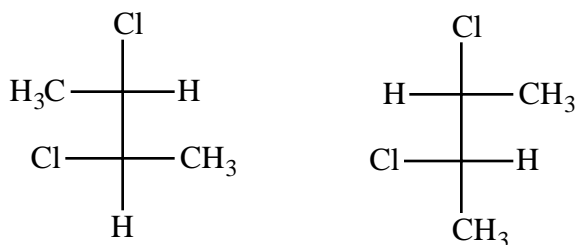


e) none of these

5. Which term below best describes the mechanism of the following reaction?



- a) S_N1
 b) S_N2
 c) E1
 d) E2
 e) Free Radical Halogenation
6. Consider the reaction of *cis*-2-butene with Br₂ in CH₂Cl₂. Which statement concerning this reaction is correct?
- a) This product is optically active because it possesses two chirality centers.
 b) This product is optically inactive because it is a racemic mixture of enantiomers.
 c) This product is optically inactive because it is meso.
 d) This product is optically inactive because it does not possess any chirality centers.
 e) This product is optically inactive because it is a racemic mixture of diastereomers.
7. Which term best describes the relationship between the two structures shown?



- a) constitutional isomers
 b) enantiomers
 c) diastereomers
 d) identical, but not meso
 e) meso, and identical
8. Which of the following alkyl halides would be expected to react the fastest under S_N2 conditions?
- a) 1-bromo-2-methylbutane
 b) 2-bromo-2-methylbutane
 c) 2-bromo-3-methylbutane
 d) 1-bromo-3-methylbutane
9. Which alkyl halide is expected to undergo S_N1 hydrolysis most rapidly?
- a) (CH₃)₃Cl
 b) (CH₃)₃Br
 c) (CH₃)₃CCl
 d) (CH₃)₃CF
 e) They would all react at the same rate.

10. How many stereoisomers of 2,3,3,4,5-pentabromohexane exist?

- a) 2
- b) 3
- c) 4
- d) 8
- e) 16

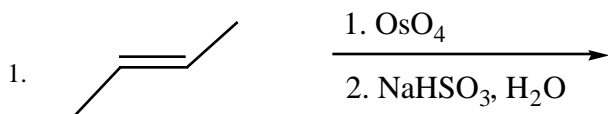
11. Assume that you have carried out a radical chlorination reaction on (R)-2-chloropentane and have isolated (in low yield) 2,4-dichloropentane. How many stereoisomers of the product are formed? Are any of the isomers optically active?

- a) Four stereoisomers are formed; three are optically active
- b) Two stereoisomers are formed; one is optically active.
- c) Two stereoisomers are formed; both are optically active.
- d) Four stereoisomers are formed; all four are optically active.
- e) Three stereoisomers are formed; two are optically active.

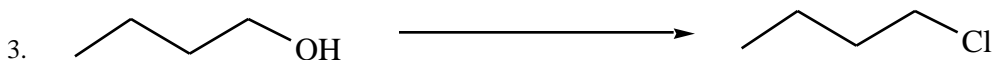
Part I Answer Key:

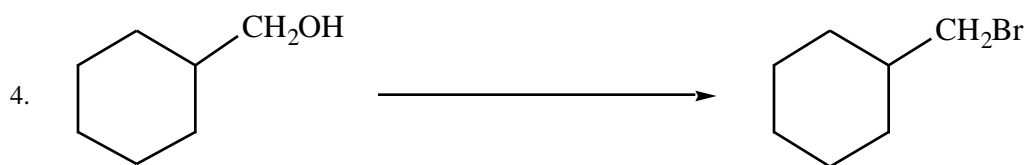
- | | | |
|------|-------|-------|
| 1. a | 6. b | 11. b |
| 2. a | 7. e | |
| 3. c | 8. d | |
| 4. d | 9. a | |
| 5. a | 10. d | |

Part II. Reactions. Show the product(s) or reaction conditions of each of the following reactions. Clearly indicate the regiochemistry and stereochemistry when appropriate. (4 points each)

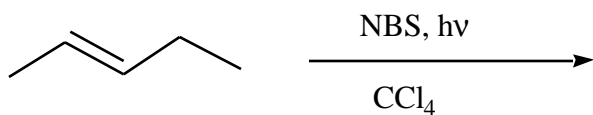


Give the R/S configuration of the product(s).





5. Draw all possible products for the following reaction:

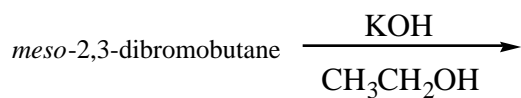


Part III. Mechanisms. (4 points each)

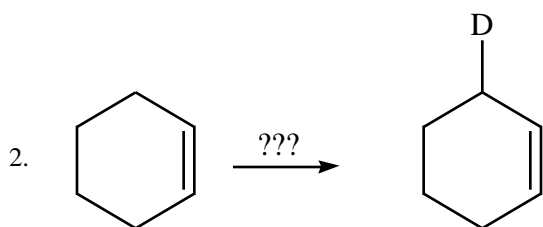
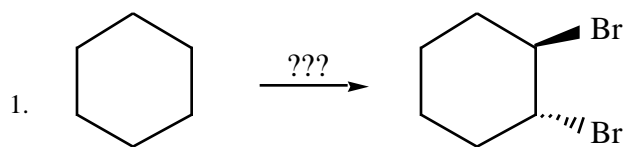
1. Write the complete mechanism for the monochlorination of methane. Include all steps, and provide the appropriate labels for the steps ("initiation", etc.).

2. Draw the complete mechanism for the reaction of (R)-2-bromobutane with NaCN in DMSO. Use the curved arrow formalism.

3. Draw the complete mechanism for the following reaction using the curved arrow formalism. (Assume only one equivalent of base reacts.)



Part IV. Synthesis. Show how the following syntheses could be performed. More than one step may be required. Show all reagents and all intermediate compounds in your synthetic scheme. (4 points each)

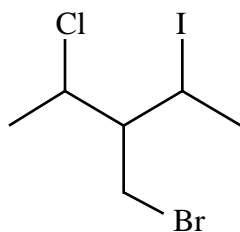


3. Show how you could convert (S)-2-pentanol to (R)-2-pentanol.

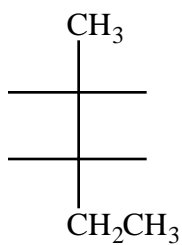
4. Starting with bromocyclohexane, show how 3-isopropylcyclohexene could be synthesized.

Part V. Short Answer. (4 points each)

1. Give the IUPAC name of the following structure:



2. Complete the structure of the following compound:



(2S,3S)-2-bromo-3-iodopentane