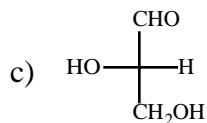
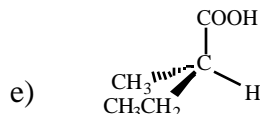
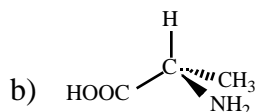
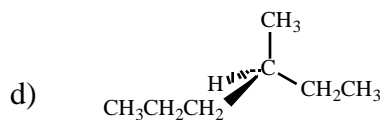
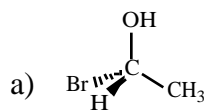


**Part I. Multiple choice.**

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



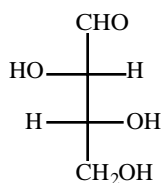
2. Which of the compounds below exists as only three stereoisomers?

- a) 1,4-dibromobutane
- b) 2,3-dibromobutane
- c) 2,3-dibromopentane
- d) 1,1-dibromocyclopentane
- e) 1,4-dibromocyclohexane

3. What is the best definition of tautomers?

- a) constitutional isomers that readily interconvert.
- b) stereoisomers that do not have a mirror image relationship.
- c) structures that differ only by rotation around single bonds.
- d) isomers that have their atoms connected in the same order but have different three-dimensional arrangements.
- e) structures that have strained carbon-carbon bonds due to steric interactions.

4. The carbohydrate D-threose has the following Fischer projection:



Assign R or S configuration to the two chirality centers in D-threose.

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

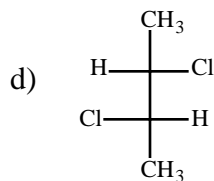
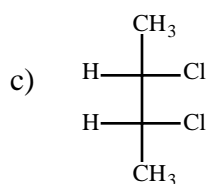
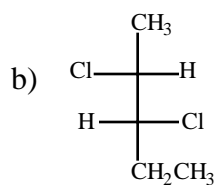
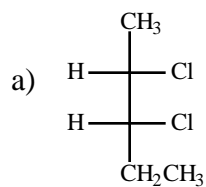
5. Which of the following compounds is/are chiral?

- I. 1,1-dichloropentane
- II. 1,2-dichloropentane

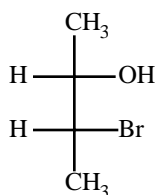
- III. 3-chloropentane  
 IV. 2,3-dichloropentane

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

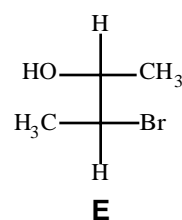
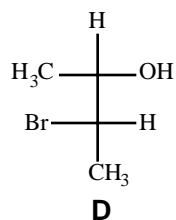
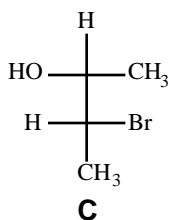
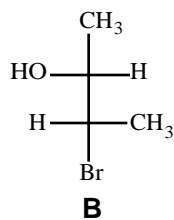
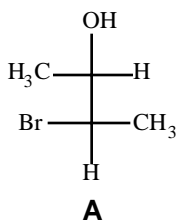
6. Which of the following is a *meso* compound?



7. Consider the molecule below:



Which of the structures shown is a diastereomer of this molecule?



8. Which of the following statements about (R)-2-methyl-1-butanol can only be confirmed by performing an experiment?

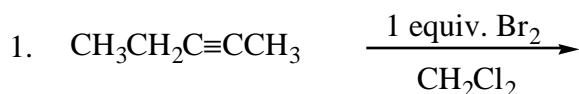
- a) It rotates plane-polarized light to the right (clockwise).  
 b) An equal mixture of it and its enantiomer is optically active.  
 c) (S)-2-methyl-1-butanol has the same boiling point.

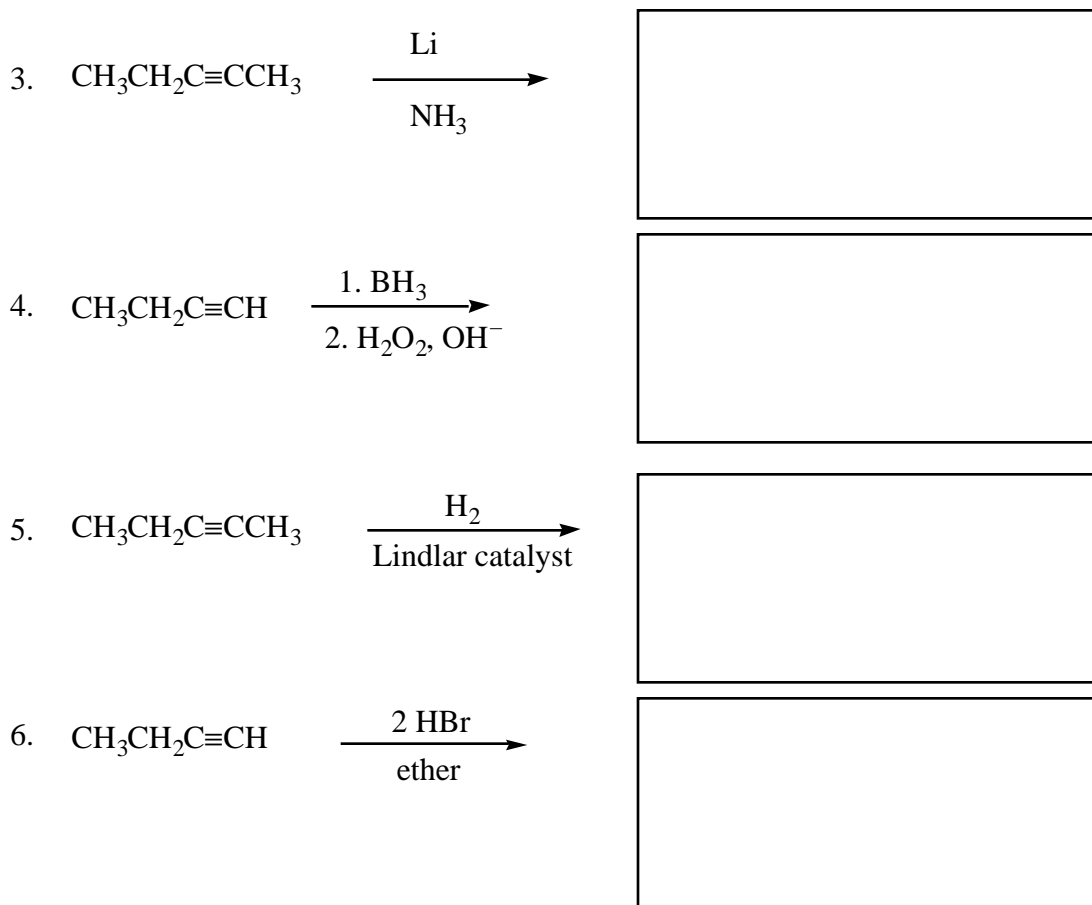
9. Which statement or statements concerning (2R, 3S)-2,3-dichloropentane and (2R, 3R)-2,3-dichloropentane is/are true?
- I. They have the same melting point.
  - II. They have the same density.
  - III. They have equal but opposite rotation of plane-polarized light.
- a) None of these.
  - b) I
  - c) II
  - d) III
  - e) I, II, and III
10. Consider the reaction of *trans*-2-butene with Br<sub>2</sub> in CH<sub>2</sub>Cl<sub>2</sub>. Which statement concerning this reaction is correct?
- a) The product is optically active because it possesses two chirality centers.
  - b) The product is optically inactive because it is a racemic mixture of enantiomers.
  - c) The product is optically inactive because it is *meso*.
  - d) The product is optically inactive because it does not possess any chirality centers.
  - e) The product is optically inactive because it is a racemic mixture of diastereomers.

**Answers to Multiple Choice Questions:**

1. e
2. b
3. a
4. c
5. b
6. c
7. e
8. a
9. a
10. c

**Part II. Reactions. Draw the reactant, product, or reagents, in the boxes as indicated. Clearly indicate the regiochemistry and stereochemistry when appropriate. (Each box is worth 4 points.)**

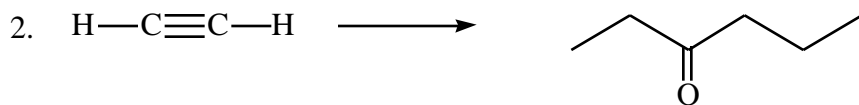
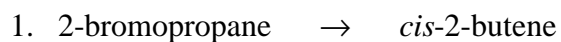




**Part III. Mechanism. (6 points)**

Show the complete mechanism for the reaction of 1-butene with HBr in ether, paying particular attention to the stereochemistry of the transition state and product(s). Use curved arrows to indicate each bond broken and each bond formed. Name the product or products.

**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. (6 points each)**



3. acetylene  $\rightarrow$  2-bromopropane

4.  $\text{CH}_3\text{CH}_2\text{C}\equiv\text{CH} \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$

**Part V. Short Answer. (6 points)**

Compound **A**,  $\text{C}_6\text{H}_{12}$ , was found to be optically active. On catalytic reduction over a palladium catalyst, one equivalent of hydrogen was absorbed, yielding compound **B**,  $\text{C}_6\text{H}_{14}$ . When compound **A** was treated with  $\text{KMnO}_4$  in an acidic solution,  $\text{CO}_2$  bubbled out and compound **C** was formed. Compound **C** has the formula  $\text{C}_5\text{H}_{10}\text{O}_2$ , and it is an optically active carboxylic acid. Draw the structures of compounds **A**, **B**, and **C**.