

## YOU MAY USE A SMALL MODEL KIT ON THIS EXAM

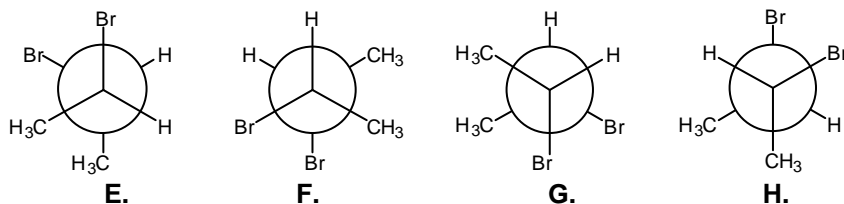
1. (32 points) Circle the letter *on the right* which corresponds to the answer to each question. There is only one correct answer for each question.

(i) Which of the following is the definition of a pair of diastereomers?

- A.** A pair of stereoisomers which are non-superimposable mirror images of one another  
**B.** A pair of structures which are superimposable mirror images of one another  
**C.** A pair of stereoisomers which are not mirror images of one another  
**D.** A pair of stereoisomers which have equal specific rotations

**A**  
**B**  
**C**  
**D**

(ii) Which of the following is a Newman projection of (*R,R*)-2,3-dibromobutane?



**E**  
**F**  
**G**  
**H**

**I**  
**J**  
**K**  
**L**

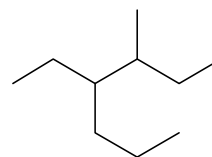
(iii) Which of the following compounds can exist as a pair of enantiomers?

- I.** 3-ethylpentane      **J.** bicyclo[2.2.1]heptane      **K.** hexane      **L.** 2-hexanol

**M**  
**N**  
**O**  
**P**

(iv) What is the correct IUPAC name for the following structure?

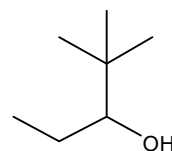
- M.** 3-methyl-4-propylhexane      **N.** 3-propyl-4-methylhexane  
**O.** 2,3-diethylheptane      **P.** 4-ethyl-3-methylheptane



**Q**  
**R**  
**S**  
**T**

(v) What is the correct IUPAC name for the following structure?

- Q.** 1-*tert*butyl-1-propanol      **R.** 2,2-dimethyl-3-pentanol  
**S.** 4,4-dimethyl-3-pentanol      **T.** 1-ethyl-2,2-dimethyl-1-propanol



(vi) How many stereoisomers exist for 2,3-dihydroxybutanoic acid,  $\text{CH}_3\text{CH}(\text{OH})\text{CH}(\text{OH})\text{CO}_2\text{H}$ ?

- U.** 2      **V.** 3      **W.** 4      **X.** 8

**U**  
**V**  
**W**  
**X**

(vii) How many isomers (constitutional, stereochemical) exist for dimethylcyclobutane?

- Y.** 3      **Z.** 4      **AA.** 5      **BB.** 6

**Y**  
**Z**  
**AA**  
**BB**

(viii) Which of the following *cannot* adopt a stable chair conformation in which there are no methyl-hydrogen 1,3-diaxial interactions?

- CC.** *trans* 1,2-dimethylcyclohexane      **DD.** *cis* 1,3-dimethylcyclohexane  
**EE.** *trans* 1,4-dimethylcyclohexane      **FF.** 1,1-dimethylcyclohexane

**CC**  
**DD**  
**EE**  
**FF**

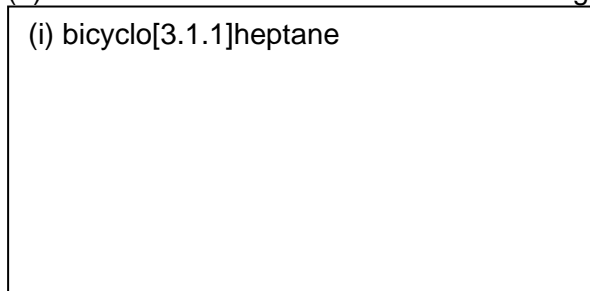
2. (36 points).

(a) Draw Newman projections of the three staggered conformations around the C2-C3 bond of butane. Circle the most stable conformation.

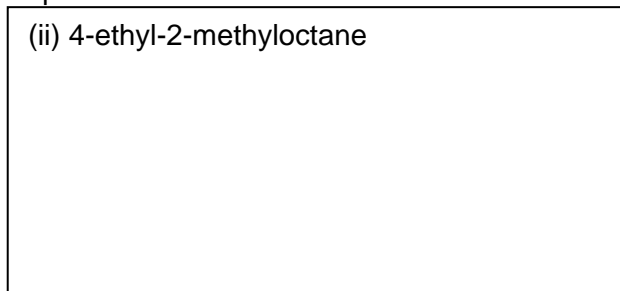


(b) Draw line-bond structures of the following compounds

(i) bicyclo[3.1.1]heptane

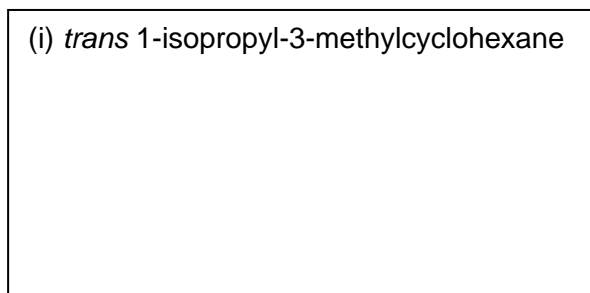


(ii) 4-ethyl-2-methyloctane

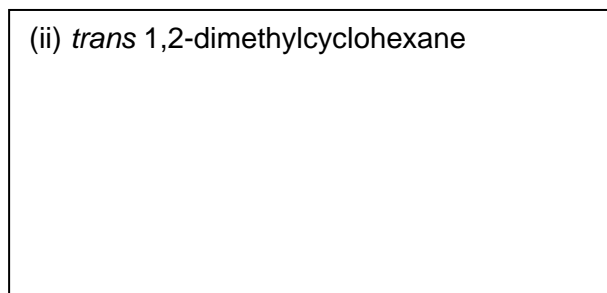


(c) Draw the most stable chair conformation of the following compounds

(i) *trans* 1-isopropyl-3-methylcyclohexane



(ii) *trans* 1,2-dimethylcyclohexane



(d) Draw structures of compounds **C** and **D** consistent with the following information. **C**,  $C_6H_{10}$ , undergoes catalytic hydrogenation to afford **D**,  $C_6H_{12}$ . **D** has two  $1^\circ$  carbons, three  $2^\circ$  carbons, and a  $4^\circ$  carbon. [Draw a single structure for each compound; there might be more than one possible answer for each]

**C**

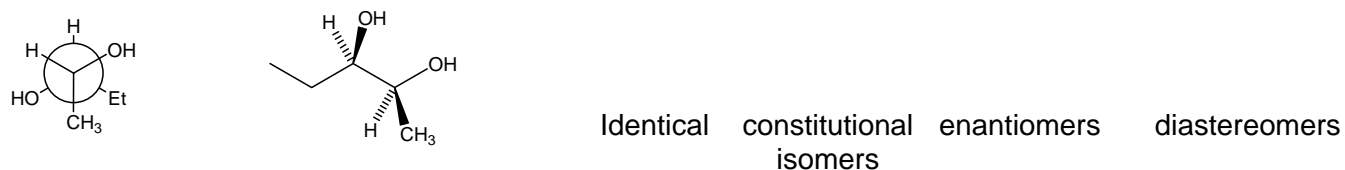
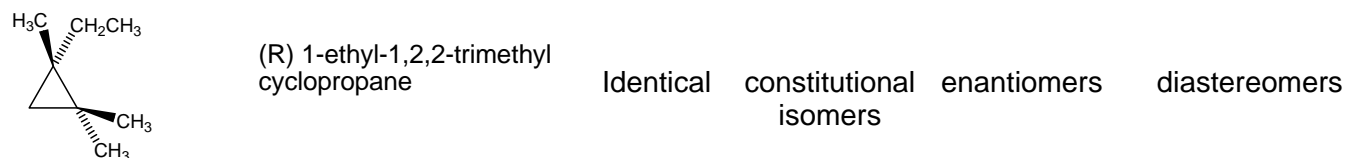
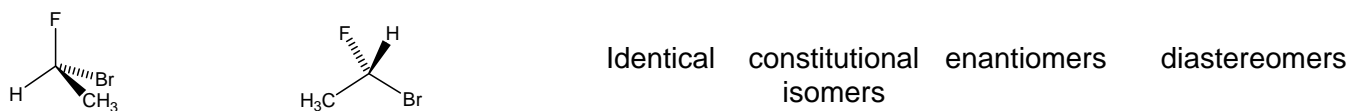


**D**

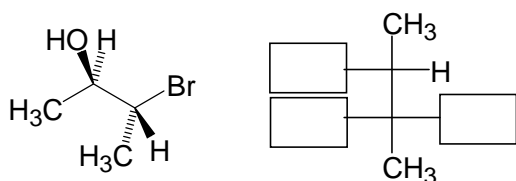


3. (36 points).

(a) What is the relationship between the following pairs of structures? Circle the correct choice on the right side.



(b) Place the remaining substituents on the Fischer projections to accurately represent the stereoisomer shown.



(c) The specific rotation,  $[\alpha]$  of the R enantiomer of a compound is  $56^\circ$ . A 2 g/mL solution of a mixture of R and S isomers in chloroform in a 10 cm polarimeter tube rotates light by  $-28^\circ$ .

(i) Which enantiomer is in excess in the mixture? \_\_\_\_\_

(ii) What is the %ee of the mixture? \_\_\_\_\_ %

(d) Assign the R/S configurations to the stereogenic centers indicated in the following two molecules

