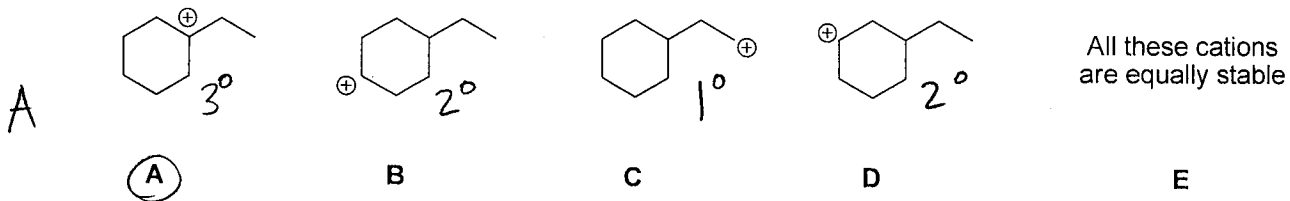


Multiple choice. Each of the following multiple choice questions (1-10) is worth 5 points and has only one correct answer. Select the best answer for each question and bubble it in on your Scantron. Only the answers on your Scantron will be considered.

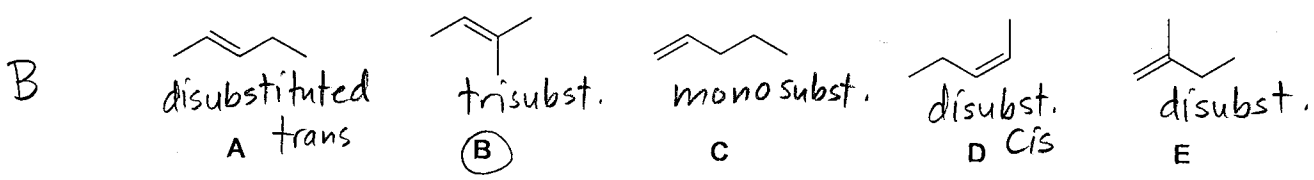
1. Identify the type(s) of strain present in cyclopropane.

- D
- a. Angle
 - b. Torsional
 - c. Steric
 - d. Angle and torsional
 - e. Angle, torsional, and steric

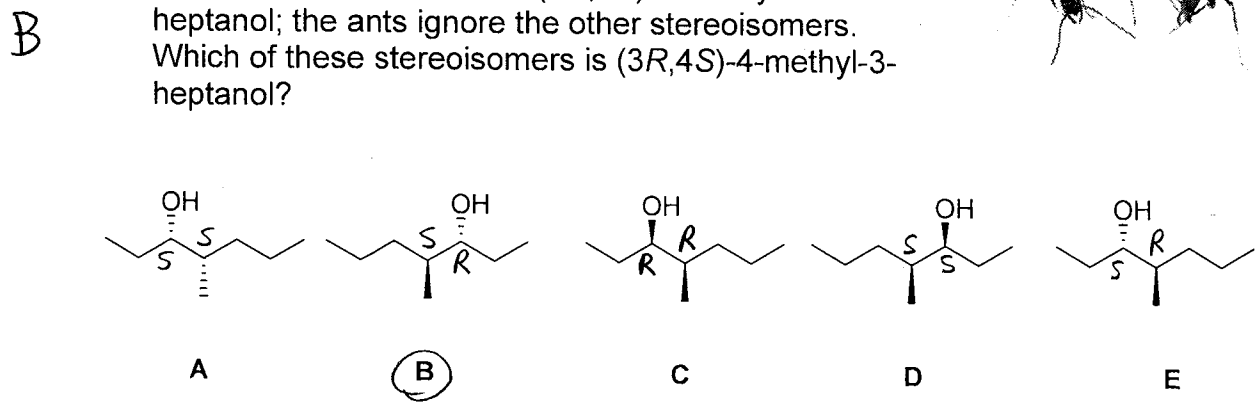
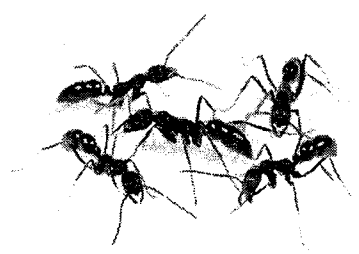
2. Select the most stable carbocation.



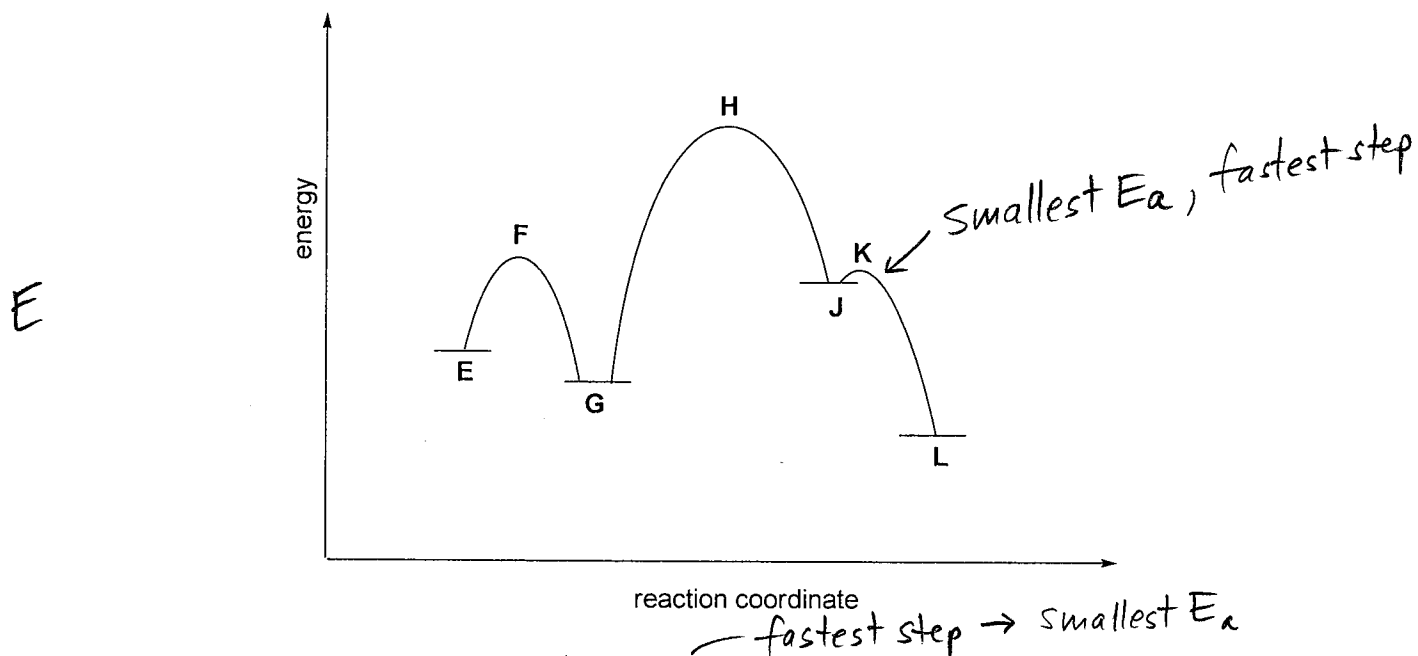
3. Select the most stable alkene in this set of isomers.



4. Pheromones are chemicals used by insects and some animals to communicate. For example, the ant species *Leptogenys diminuta* secretes one of the isomers of 4-methyl-3-heptanol to mark trails to food. The active stereoisomer is (3R,4S)-4-methyl-3-heptanol; the ants ignore the other stereoisomers. Which of these stereoisomers is (3R,4S)-4-methyl-3-heptanol?

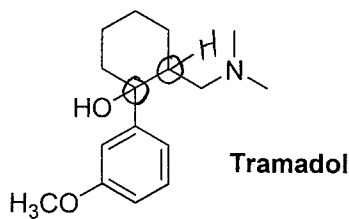


5. Here is an energy vs. reaction coordinate diagram for a multi-step reaction:



Proton transfers are often the fastest steps in organic reaction mechanisms. One of the steps in the reaction represented by the diagram is a proton transfer. Which of these species represents the transition state for the proton transfer?

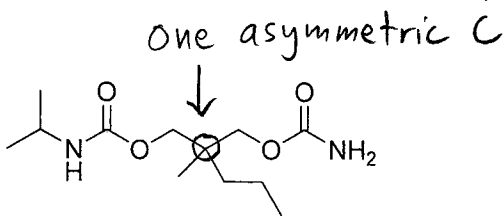
- a. F
 b. G
 c. H
 d. J
 e. K
6. Tramadol is an opiate analgesic that is marketed as a mixture of stereoisomers. How many unique stereoisomers exist for Tramadol?



2 asymmetric C's
 $2^n = 2^2 = 4$

- a. 1
 b. 2
 c. 4
 d. 8
 e. 16

7. Carisoprodol, which is sold under the brand name "Soma", is a musculoskeletal pain reliever.



A

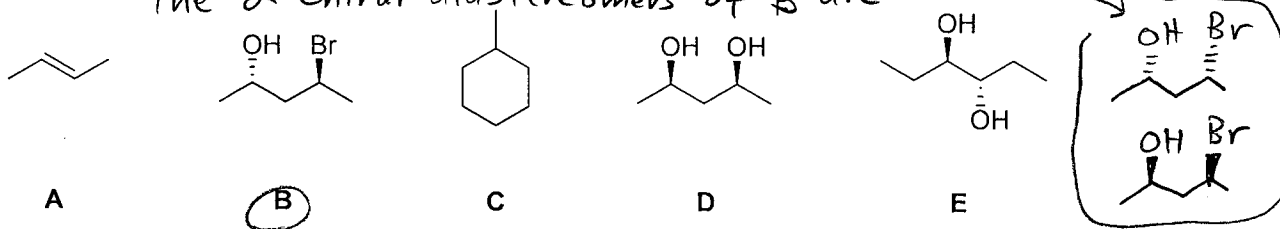
Carisoprodol (Soma)

Select the best label to describe carisoprodol.

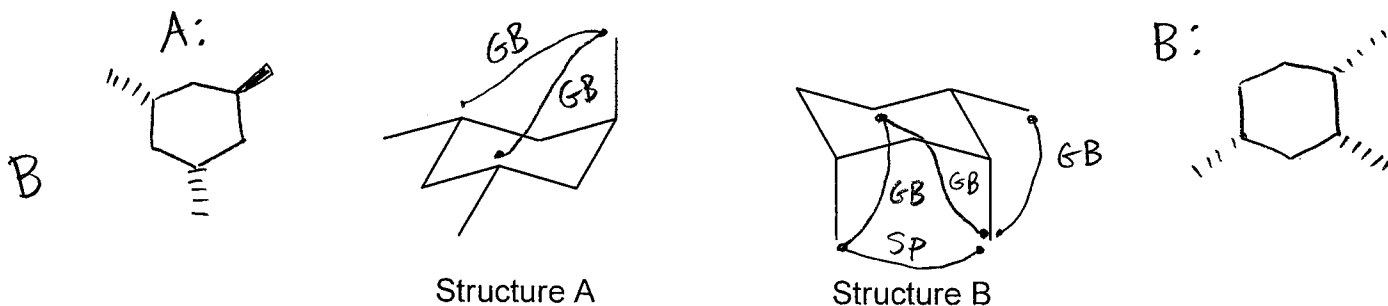
- a. Chiral
- b. Achiral
- c. Achiral and meso

8. Compound X is not superimposable on its mirror image and has two diastereomers, each of which is chiral. Which of these structures is Compound X? *A, C, D, and E are all superimposable on their mirror images. The 2 chiral diastereomers of B are*

B

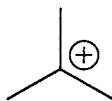


9. Select the true statement about these two structures.



- a. These structures are the two chair conformations of the same molecule. See skeletal structures; different connectivity
- b. There is a 1,3 diaxial interaction in Structure B.
- c. Structure A has more strain than Structure B. It has less strain
- d. The two structures are stereoisomers. different connectivity
- e. None of the statements "a" through "d" are true.

10. Identify the orbitals that are mixing to stabilize this carbocation by hyperconjugation.

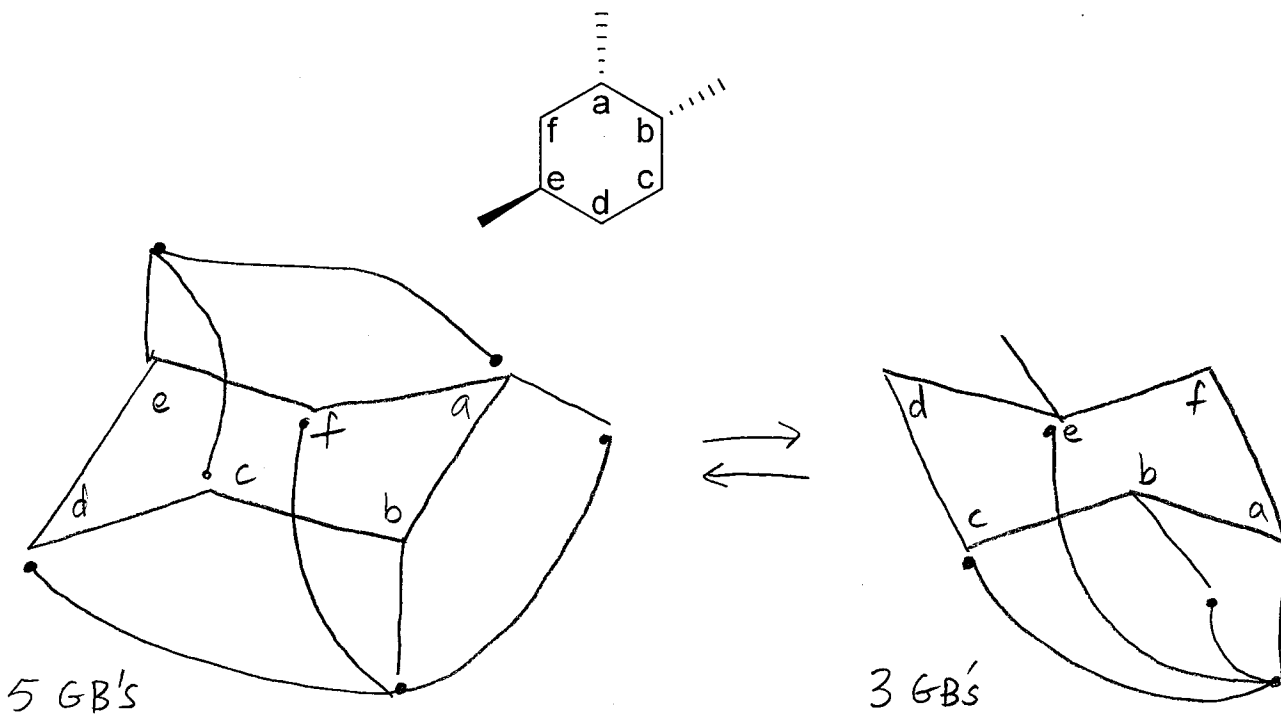


D

- a. C-H σ and C-H σ^*
- b. p and sp^3
- c. p and sp^2
- d. p and C-H σ
- e. p and C-H σ^*

Free response. Provide the requested drawings or other information for the remaining questions.

- 11a. Draw both chair conformations of the molecule shown following the guidelines presented in class. Points will be deducted for improperly drawn chairs. Do not draw all the hydrogens on the ring, just the methyl groups. Each of the carbon atoms in the structure is labeled (a, b, c, etc.). Label the carbon atoms in both your chairs to identify exactly which carbons in your drawings correspond to the labeled atoms in this structure. (10 pts)



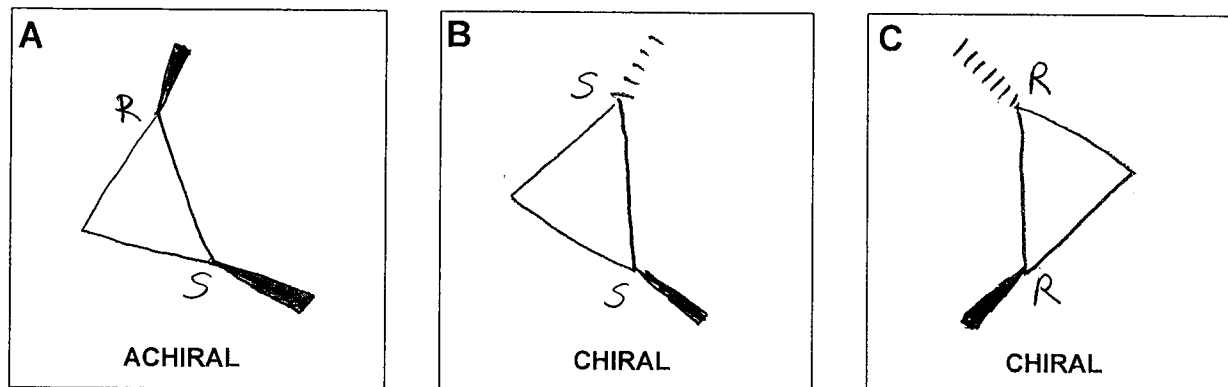
- 11b. Identify all gauche butane interactions in each chair by drawing lines between the carbons in each interaction as shown in lecture. (10 pts)

- 11c. Calculate the difference in energy between the two chair conformations. (Energy of a gauche butane interaction = 0.8 kcal/mol) (5 pts)

$$5 \text{ GB's} \quad - \quad 3 \text{ GB's}$$
$$0.8 \times 5 = 4.0 \frac{\text{kcal}}{\text{mol}} \quad - \quad 0.8 \times 3 = 2.4 \frac{\text{kcal}}{\text{mol}} = \boxed{1.6 \frac{\text{kcal}}{\text{mol}}}$$

12. There are three unique stereoisomers of 1,2-dimethylcyclopropane. Two are chiral, and one is achiral.

12a) Draw all three stereoisomers in the boxes provided, using skeletal structures (**notice the labels in the boxes!**). Show stereochemistry at each asymmetric carbon using wedge and dash notation. (9 pts)



12b) Assign an *R* or *S* absolute configuration to each asymmetric carbon in your structures. (6 pts)

12c) What is the stereochemical relationship of the two chiral isomers? (3 pts)

Identical

Diastereomers

Enantiomers

12d) What is the stereochemical relationship of the achiral isomer to either of the chiral isomers? (3 pts)

Identical

Diastereomers

Enantiomers

12e) Which two structures, when combined in the correct proportions, would form a racemic mixture? (Use the labels in the upper left corner of the boxes.) (2 pts)

B and C

12f) Is the achiral structure a meso compound? Circle one: **Yes** No (2 pts)