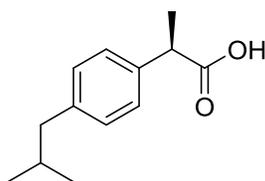


1. Ibuprofen is a commonly used pain reliever called an NSAID (non-steroidal anti-inflammatory drug). Its *S* enantiomer is more biologically active; however, an enzyme in our bodies converts the *R* enantiomer into the *S* enantiomer so the medication may be administered as a racemic mixture.

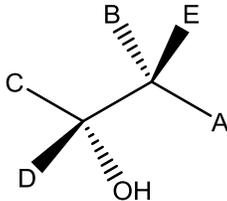
Which enantiomer is this?



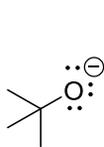
Ibuprofen

- a. *R*
b. *S*
2. Refer to the structure of ibuprofen in question 1. When ibuprofen, a carboxylic acid, is treated with the strong base sodium hydroxide, a proton transfer occurs. What is the LUMO in the reaction?
- a. Nonbonding MO
b. O-H σ
c. O-H σ^*
d. *p*
e. C-H σ^*
3. When ibuprofen reacts with sodium hydroxide as described in question 2, what is the HOMO in the reaction?
- a. Nonbonding MO
b. O-H σ
c. O-H σ^*
d. *p*
e. C-H σ^*
4. What is the approximate difference in energy between the two chair conformations of cis-1,2-dimethylcyclohexane?
- a. 0.8 kcal/mol
b. 1.6 kcal/mol
c. 2.4 kcal/mol
d. 3.2 kcal/mol
e. There is no energy difference between the two chair conformers.

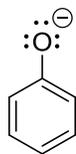
5. In the structure shown, which of the indicated groups is **anti** to the OH group?



6. Select the **strongest** base.



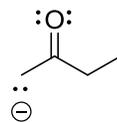
A



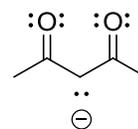
B



C

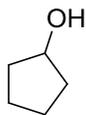


D

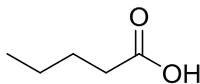


E

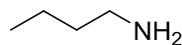
7. Arrange the three acids in order of **decreasing** pK_a .



W



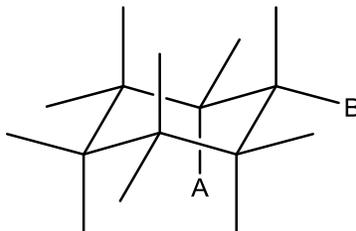
X



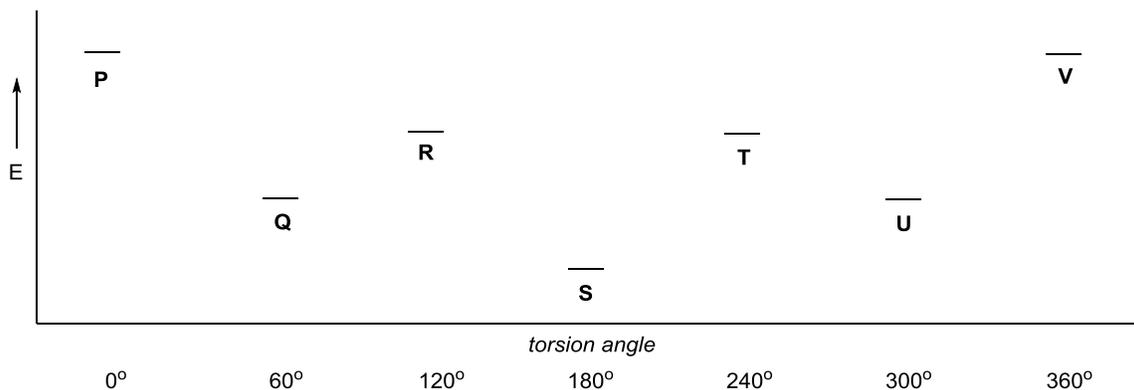
Y

- $W > X > Y$
- $Y > X > W$
- $Y > W > X$
- $W > Y > X$
- $X > Y > W$

8. In this chair structure, substituents "A" and "B" are:



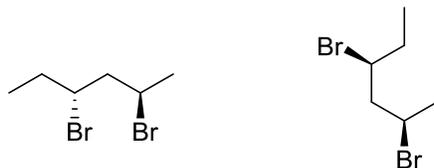
- anti and trans
 - anti and cis
 - gauche and trans
 - gauche and cis
 - none of these
9. Consider the different conformations of 2,3-dimethylbutane looking down the C2-C3 bond. The relative energies of the conformations are plotted for you below as a function of torsion (dihedral) angle:



Which of these conformers or pairs of conformers has the **greatest number** of gauche butane interactions?

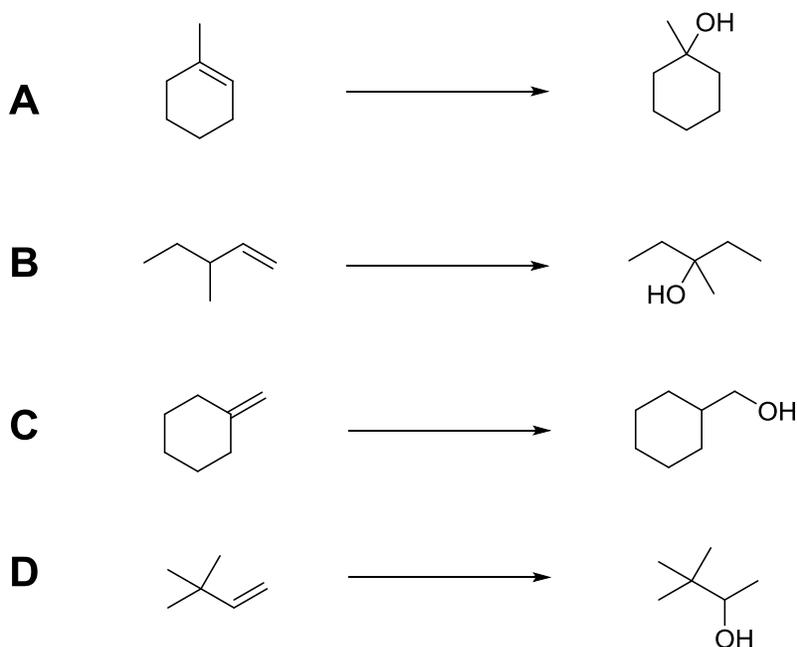
- P and V
- Q and U
- R and T
- S
- There are no gauche butane interactions in any of the conformations.

10. What is the relationship between these two structures?

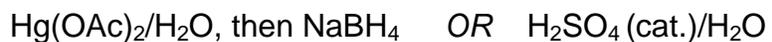


- a. Constitutional isomers
- b. Diastereomers
- c. Enantiomers
- d. Identical
- e. None of the above

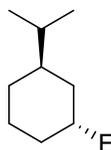
For questions 11-13, refer to the list of reactions shown here. Some answer choices may be used more than once, or not at all.



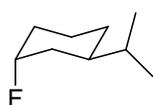
- 11. Which reaction has an anti-Markovnikov alcohol as the product?
- 12. In which reaction did a carbocation rearrangement occur?
- 13. For which reaction could you use EITHER of these conditions to give the product shown as the major product?



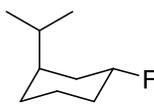
14. The “A” value (ΔG) for an isopropyl group is 2.1, and for a fluorine atom it is 0.25. Select the most stable conformation of this molecule from the choices given.



A



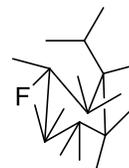
B



C



D



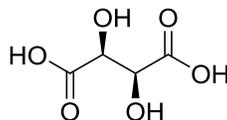
New Isopropyl
Bowtie Pasta
(Now With
Added
Fluorine)

E

15. How many stereoisomers are there for 1,2-dimethylcyclopropane?

- 1
- 2
- 3
- 4

16. Here is one of the stereoisomers of tartaric acid, a naturally occurring compound found in grapes and bananas. Which of these terms is the best description of this structure?



- Achiral
- Achiral and meso
- Chiral

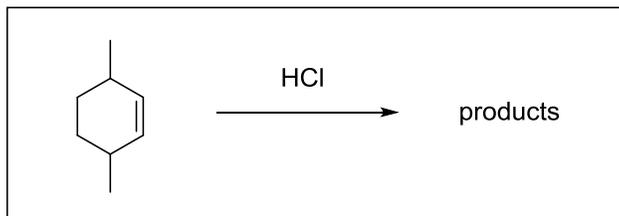
17. Which of these orbitals forms when two carbon p orbitals, one on each carbon atom, combine in the manner shown here?



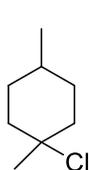
- a. σ
b. σ^*
c. π
d. π^*
18. What is the label for the orbital shown in question 17?

- a. Bonding
b. Antibonding
c. Nonbonding
19. Water is
- a. a weak acid
b. a weak base
c. both a and b
d. neither a nor b

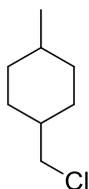
20. Consider the following reaction conditions:



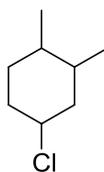
Which of these structures is the most likely **major product** of the reaction?



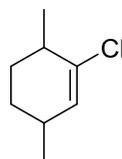
A



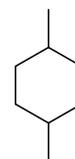
B



C

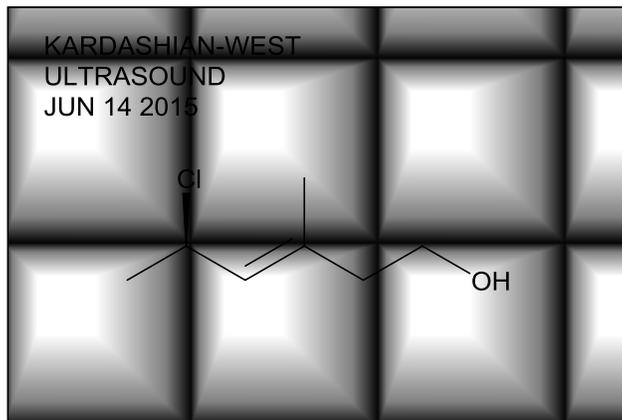


D



E

25. Kim Kardashian and Kanye West are having another baby! An ultrasound examination showed that the baby looks like this:



Although both parents are secretly very concerned that the baby does not resemble either one of them, Kim wants to call the baby “Khiral Kardashian”, while Kanye thinks that the child should be named “Gauche West”. However, IUPAC, the society of chemists that establishes naming rules, has insisted that the child be given a proper chemical name.

What should be the correct name of the child, according to IUPAC?

- (3*E*, 5*R*)-5-chloro-3-methyl-3-hexen-1-ol
- (2*R*, 3*E*)-2-chloro-4-methyl-3-hexen-6-ol
- (3*E*, 5*S*)-5-chloro-3-methyl-3-hexen-1-ol
- (2*S*, 3*E*)-2-chloro-4-methyl-3-hexen-6-ol
- None of these choices is the correct name of the “child”.