

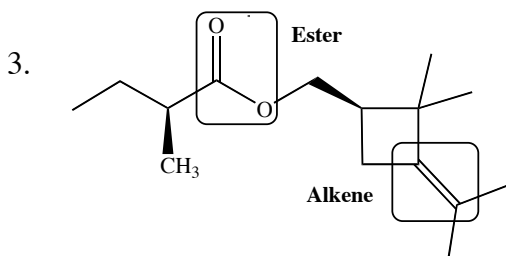
Statistics:

High score = 93 Average score = 77.3 Low score = 53
 Standard Deviation = Irrelevant as it does not control grade distribution in this class.

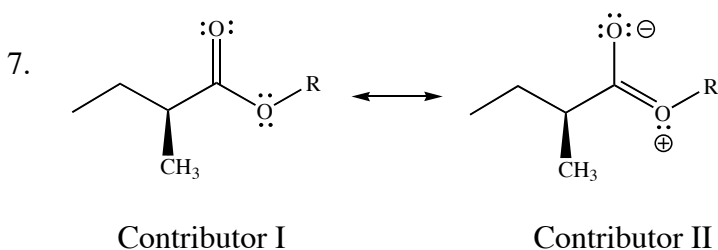
A note about exam keys: The answers presented here are usually significantly longer than expected from a student taking the exam. An exam key serves not only to reveal what was expected, but to instruct you as well.

To see the final course grade cutoffs, consult the grading scale on the Chem 30A course web page.

1. $C_{15}H_{26}O_2$
2. **Zero** atoms with open octets, **four** lone pairs, **three** sp^2 carbons and **six** methyl groups.



4. $>109.5^\circ$ but $<120^\circ$
5. $O (3.5) > C (2.5) > H (2.1)$
6. The $C=O$ is called a **carbonyl group**. The atom that bears the $\delta+$ charge is the **carbon**. When hydroxide ion approaches this $C=O$, it approaches the **carbon** atom.

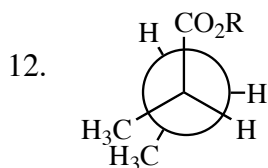
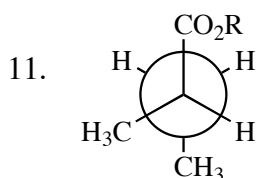
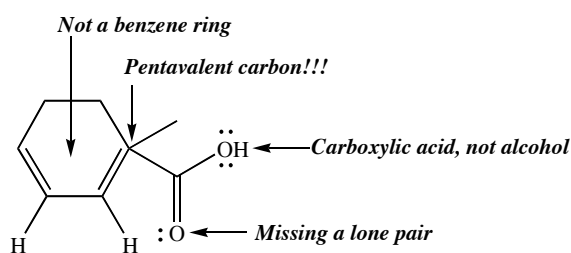


Contributor I makes the greatest contribution to the resonance hybrid.

The hybrid is the best representation of reality.

8. (a) The group on the wide end of the wedge is rising out of the paper (or chalkboard or computer screen) toward the viewer.
 (b) The "R" abbreviation is used to denote a generic, unspecified carbon-based group such as a methyl group or a benzene ring.

9. (a) A molecule is said to have resonance if it cannot be adequately represented by a single Lewis structure.
- (b) Functional groups are important because they are the basis for all the physical, chemical and biological properties of any molecule. They are the foundation for nomenclature, and the basis for an effective way to organize the concepts encountered while learning organic chemistry.
- (c) Orbital hybridization is the quantum mechanical (mathematical) mixing of pure atomic orbitals (s , p and sometimes d) to give molecular geometry that cannot be obtained by bonding with nonhybridized atomic orbitals.
10. The structure has eight carbons. Other errors:

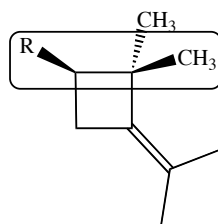


The CH_3/CH_3 dihedral angle is 0° .

The CH_3 groups of this eclipsed conformation are **syn-periplanar**.

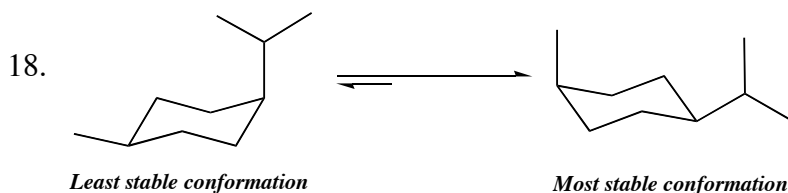
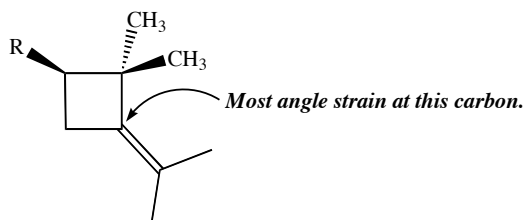
The eclipsed conformation is **less stable** than the staggered conformation.

13. Strain: An increase in molecular potential energy due to less than ideal bonding or geometry.
14. Torsional strain: Strain caused by electron repulsion due to the close proximity of electron clouds.
15. The greatest torsional strain results from the largest groups in the closest proximity (in this case, the CO_2R group and the *cis*- CH_3).

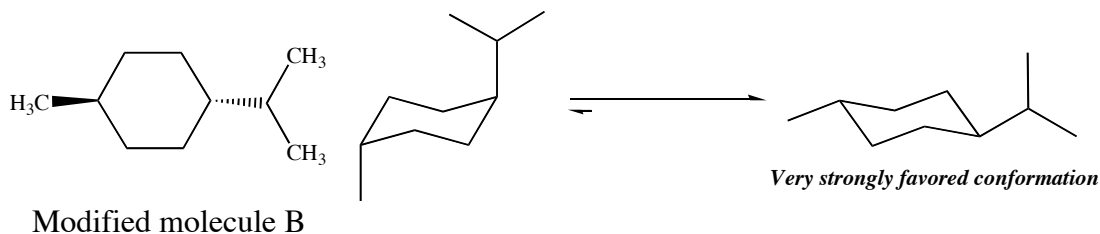


16. Angle strain: Strain caused by reduced orbital overlap due to a deviation from preferred bond angles.

17. An sp^2 carbon's preferred bond angle is 120° whereas an sp^3 carbon's preferred bond angle is 109.5° . The interior angles of a square are 90° . This causes in greater strain at the sp^2 carbon than at the sp^3 carbons.

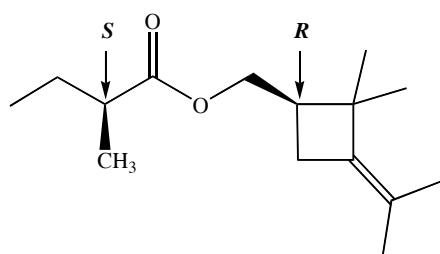


19. When the methyl and isopropyl groups are cis (question 18), one will always be axial and the other equatorial. If the groups are trans, they will both be either axial or equatorial. When the difference between two chair conformations is two groups axial versus no groups axial, there is a strong preference to remain in the “no axial” conformation.

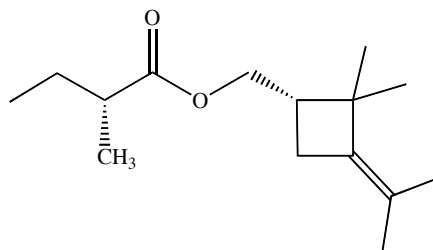


20. Stereoisomers: Isomers that have the same sequence of atom attachment, but differ in the position of the atoms in space, and cannot be interconverted by rotation around a single bond.

21. Molecule A has **two** stereocenters.



Stereocenter labels

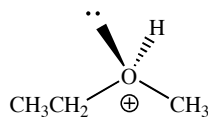


Enantiomer

22. Optically active, chiral and levorotatory.

23. Its activity cannot be guessed

24. In order to be a stereocenter the oxygen atom must bear four different attachments: one hydrogen, two carbon groups and one pair. One of the few possible answers is given here.



Oxygen with a 2+ formal charge is never encountered in general or organic chemistry.