

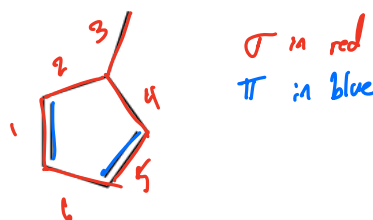
CHEM 223 (2024) SI Summary Session #1

Learning Objectives: By the end of this session, students should be able to:

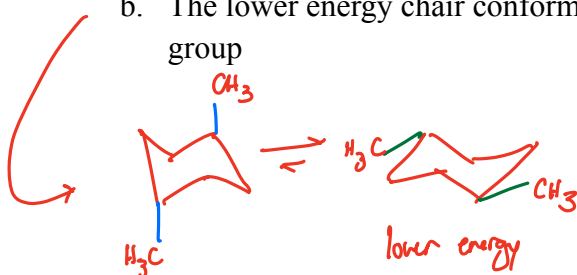
1. Crush exam 1!

Section 1. Multiple Choice

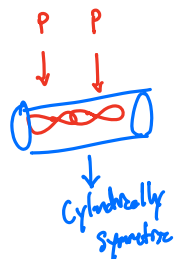
1. A carbon-hydrogen bond in ethan (CH_3CH_3) is best described as a ____ bond
 - a. Highly polar
 - ☒ b. Essentially nonpolar
 - c. Ionic
 - d. Resonance Stabilized
2. How many carbon-carbon σ -bonds are present in the molecule below?



- a. 0
 - b. 2
 - c. 4
 - ☒ d. 6
3. Which of the following statements is correct?
 - ☒ a. High molecular dipole values are associated with nonpolar molecules
 - ☒ b. All polar molecules can form hydrogen bonds
 - ☒ c. The polarity of a molecule is dependent on its three-dimensional structure
 - ☒ d. Induced-dipole interactions are stronger than dipole-dipole interactions
 4. Which of the following is used to indicate two carbon atoms connected by a double bond?
 - ☒ a. Alkane
 - ☒ b. Alkene
 - ☒ c. Alkyne
 5. Which of the following best describes the chair conformation of trans 1,4 dimethylcyclohexane
 - a. The two chairs are of equal energy
 - b. The lower energy chair conformation has one axial and one equatorial methyl group

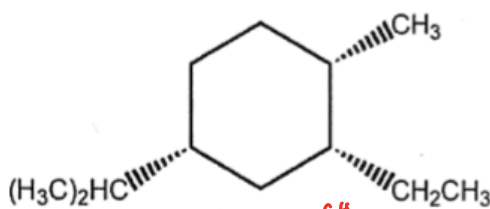


- c. The higher energy chair conformation has one axial and one equatorial methyl group
- d. The lower energy chair conformation has two equatorial methyl groups



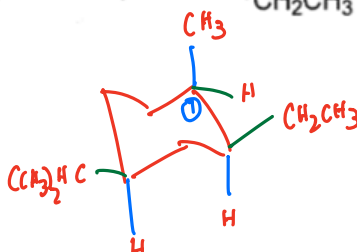
6. Which of the following statements about σ molecular orbitals is correct?
- a. σ molecular orbitals are cylindrically symmetric
- b. Most of the electron density in a σ molecular orbital is centered above and below the internuclear axis *true for π -MOs.*
- c. When two atoms are connected by a triple bond, all of these bonds are σ bonds *1 σ , 2 π*
- d. None of the above

7. In the lowest energy conformation of the compound below, how many alkyl groups are equatorial?

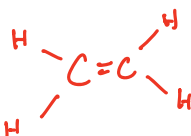


*pg 138 / 143
for chair stuff*

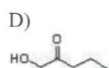
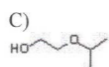
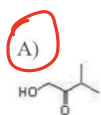
- a. 0
- b. 1
- c. 2
- d. 3
8. Which of the following molecules cannot hydrogen bond to another of the same compound?



- a. $\text{CH}_3\text{COOCH}_2\text{CH}_3$
- b. $\text{CH}_3\text{CH}_2\text{COOH}$
- c. $(\text{CH}_3)_2\text{COH}$
- d. $\text{H}_2\text{NCH}_2\text{CH}_3$
9. Which compound has no net molecular dipole moment?
- a. CH_3Cl
- b. C_2H_4
- c. CH_2O
- d. CH_3NH_2



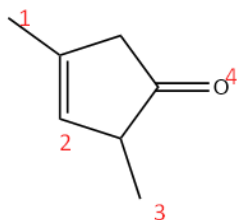
10. Select the line-angle structure that corresponds to the condensed structure,



11. In the structure below, the σ -bond of the carbonyl is formed by the overlap of the _____ orbital on the carbon and the _____ orbital of oxygen.

- a. sp^3 , sp^3
- b. sp^2 , sp^3
- c. sp^2 , sp^2
- d. sp , sp

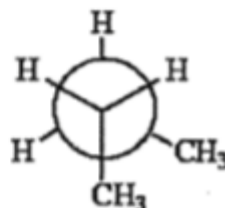
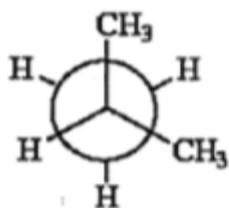
12. Which of the labeled atoms is sp^2 hybridized?



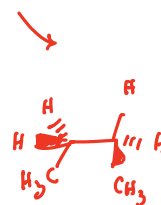
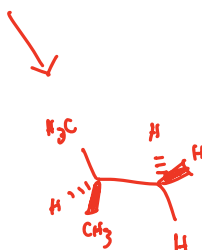
(refer to # 11 as well)

- a. 1, 2
- b. 3, 4
- c. 1, 3
- d. 2, 4

13. The relationship between the structures below is

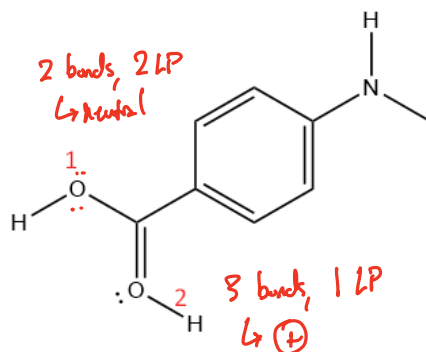


- a. Not isomers
- b. Conformers
- c. Constitutional Isomers



d. Cis-Trans Isomers

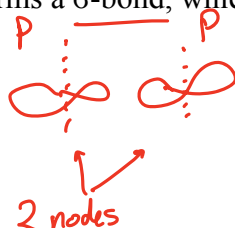
14. The charges on the two oxygens shown are:



- ☒ a. Oxygen 1: 0, Oxygen 2: 0
- ☒ b. Oxygen 1: 1, Oxygen 2: 0
- ☒ c. Oxygen 1: 0, Oxygen 2: 1
- ☒ d. Oxygen 1: 0, Oxygen 2: -1

15. The overlap of 2 p orbitals forms a σ -bond, which has ____ nodes.

- a. 0
- b. 1
- ☒ c. 2
- d. 3



16. Among the butane conformers, the energy maximum on a graph of potential energy occurs when the dihedral angle adopts a ____ conformation

- a. Eclipsed
- ☒ b. Totally Eclipsed
- c. Anti
- d. Gauche

↓
least stable

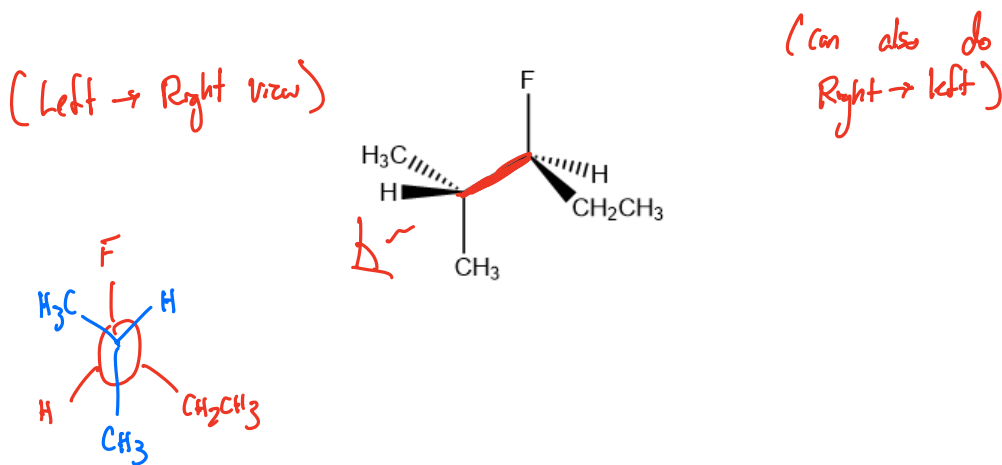
17. Out of n-hexane, 2,3-dimethylbutane, and 2-methylpentane, which of the following lists their boiling points in increasing order?

- a. 2-methylpentane, n-hexane, 2,3-dimethylbutane
- ☒ b. 2,3-dimethylbutane, 2-methylpentane, n-hexane
- c. n-hexane, 2,3-dimethylbutane, 2-methylpentane
- d. None of the above

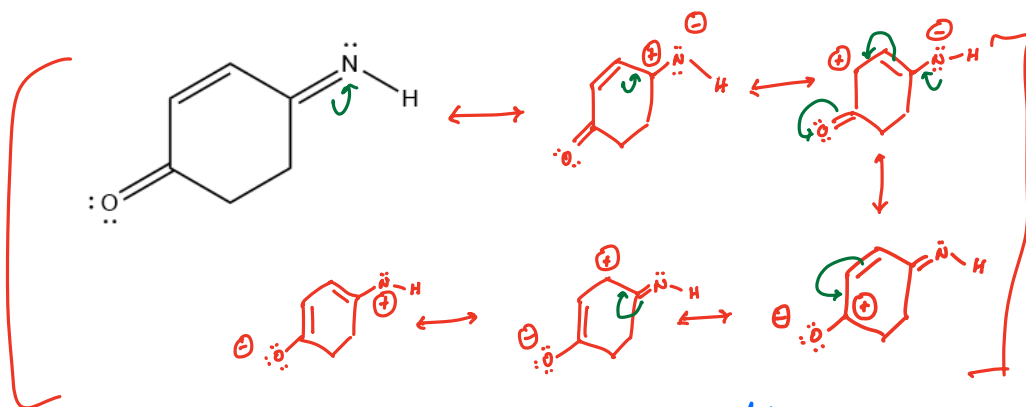
more linear = more surface area

Section 2: Short Answer

18. Without changing conformation, convert the following perspective drawing into a newman projection.



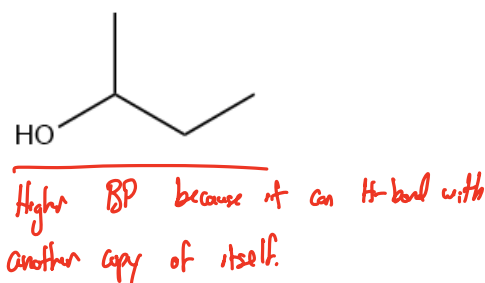
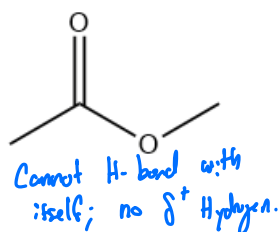
19. Draw additional resonance contributors for the following compound.



note: I skipped carbanion intermediates.

You can also combine many of these arrows.

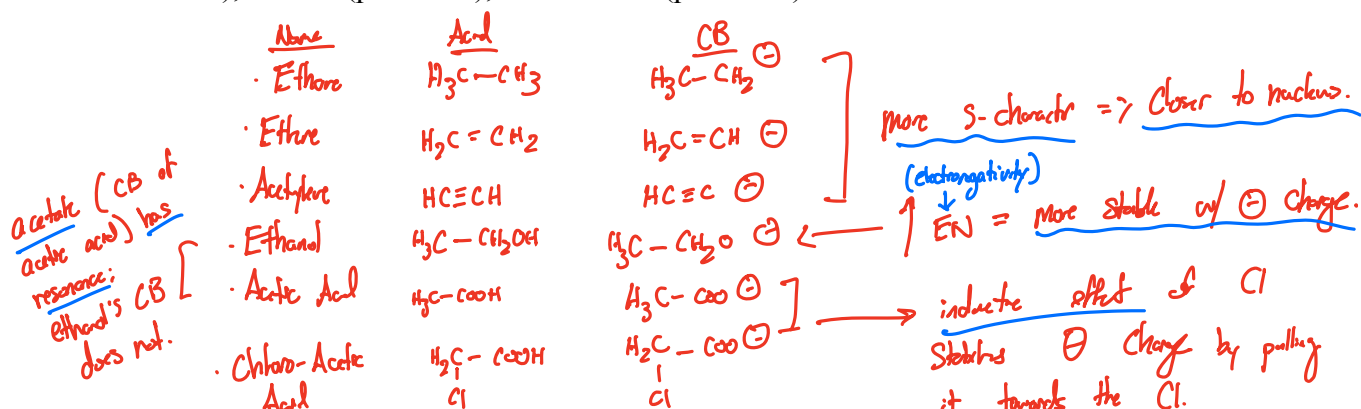
20. Which of the following compounds has a higher boiling point? Briefly explain your reasoning.



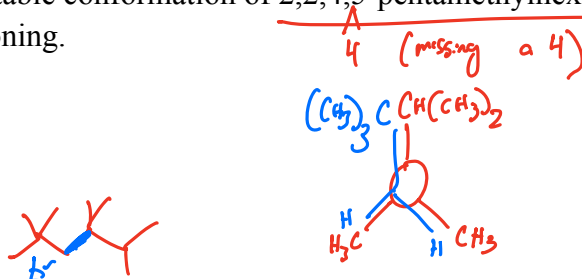
Section 3: Free Response

21. Rank the following compounds in order of increasing acidity. Explain your reasoning.

Chloroacetic Acid (pKa ~ 3), Acetic Acid (pKa ~ 5), Acetylene (pKa ~ 25), Ethene (pKa ~ 44), Ethane (pKa ~ 50), and Ethanol (pKa ~ 16)



22. Provide the least stable conformation of 2,2,4,5-pentamethylhexane down C3-C4. Explain your reasoning.



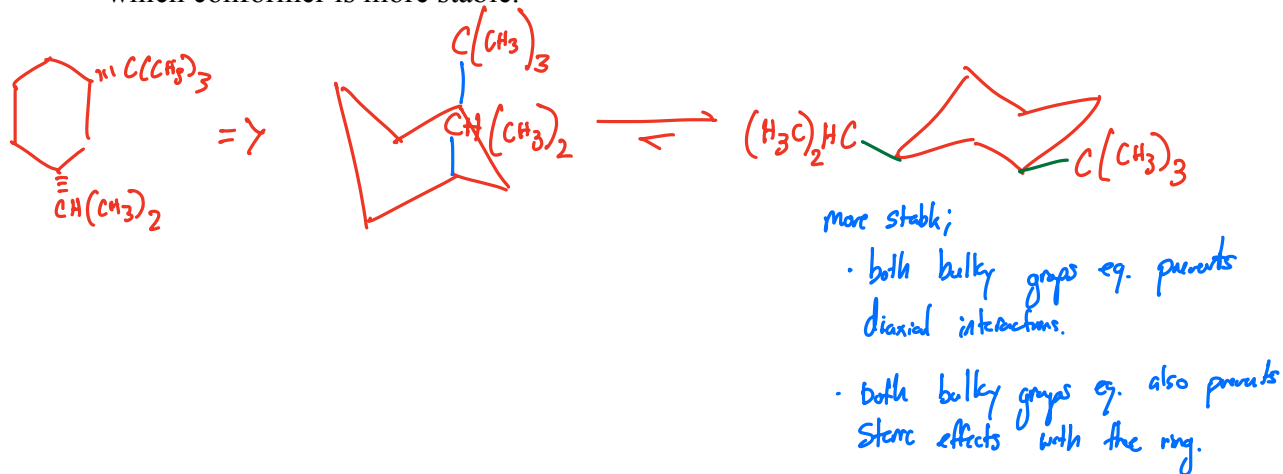
least stable;

• eclipsed bonds \Rightarrow highest torsional strain.

• overlapping groups \Rightarrow highest steric strain.

Cis (sorry)

23. Draw the two chair conformations of 1-(t-butyl)-3-isopropylcyclohexane, and explain which conformer is more stable.



24. Use curly arrows to show the progression of the following chemical reaction. Identify the nucleophile and electrophile.

