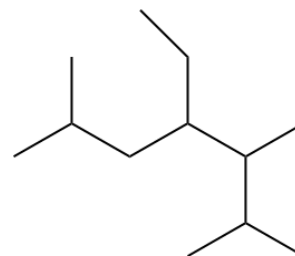


Chem 51A Midterm 1 Review

Part A: Multiple Choice (14 questions)

1. Which of the following molecular formulas corresponds to the given skeletal structure?

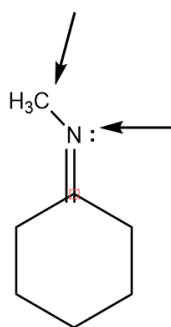
- a. $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_2\text{CH}_3\text{CH}(\text{CH}_2)_3\text{CH}_2\text{CH}_2\text{CH}_3$
- b. $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}(\text{CH}_2\text{CH}_3)\text{CH}(\text{CH}_3)\text{CH}(\text{CH}_3)_2$
- c. $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}(\text{CH}_2\text{CH}_3)\text{CH}_2\text{CH}_2\text{CH}_3$
- d. Too many C and H idk



2. What is the ground state electron configuration for the element Sulfur (S)?

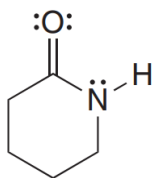
- a. $1s^22s^22p^6$
- b. $1s^22s^22p^6$
- c. $1s^22s^22p^63s^23p^6$
- d. $1s^22s^22p^63s^23p^4$

3. Determine the hybridization between the 2 atoms below.

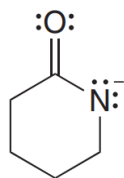


- a. $\text{C}_{\text{sp}^3}\text{-N}_{\text{sp}^3}$
- b. $\text{C}_{\text{sp}^3}\text{-N}_{\text{sp}}$
- c. $\text{C}_{\text{sp}^3}\text{-C}_{\text{sp}^2}$
- d. $\text{C}_{\text{sp}^3}\text{-N}_{\text{sp}^2}$

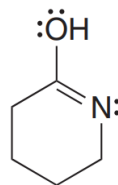
4. Circle 2 of the following compounds that are constitutional isomers.



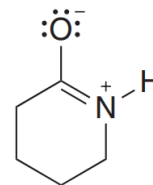
A



B

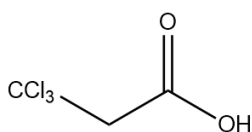


C

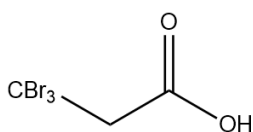


D

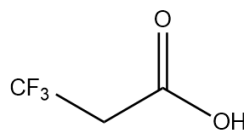
5. Which of the following compounds is the most acidic?



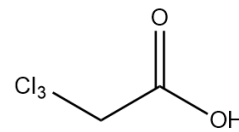
I.



II.



III.



IV.

- a. I
- b. II
- c. III
- d. IV

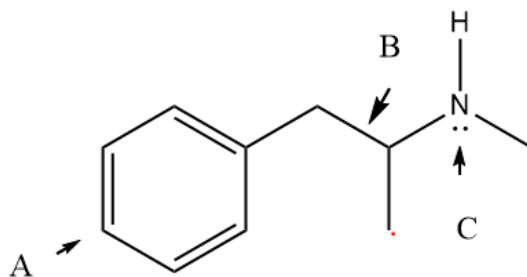
6. Which atomic orbitals overlap to form the C-H bond in ethylene (CH₂CH₂)? Which atomic orbitals overlap to form the C-C **sigma** bond in ethylene?

- a. C_{sp3}-H_{sp3}, C_{sp3}-C_{sp2}
- b. C_{sp2}-H_{sp3}, C_{sp2}-C_{sp3}
- c. C_{sp2}-H_{1s}, C_{sp2}-C_{sp2}
- d. C_{sp3}-H_{1s}, C_{1s} - C_{1s}

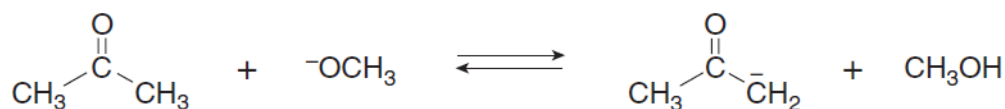
7. Which of the following correctly orders **increasing** C-H bond length?

- I. H-C ≡CH
 - II. H-CH₂-CH₃
 - III. H-CH=CH₂
- a. I < II < III
 - b. II < I < III
 - c. III < I < II
 - d. II < III < I
 - e. I < III < II

8. Which of the following correctly orders **decreasing** C-H bond strength?(from question 7)
- I < II < III
 - II < I < III
 - III < I < II
 - II < III < I
 - I < III < II
9. In describing the **quantum mechanical model of the atom**, which of the following is **not** true?
- An atomic orbital is a mathematical function that describes the wave-like behavior of electrons
 - Antibonding orbitals are filled up when forming molecules
 - Antibonding orbitals are lower in energy than bonding orbitals
 - Additional electrons go into anti-bonding orbitals when bonding orbitals are filled
10. Which of the following statements about the molecule is **true**?

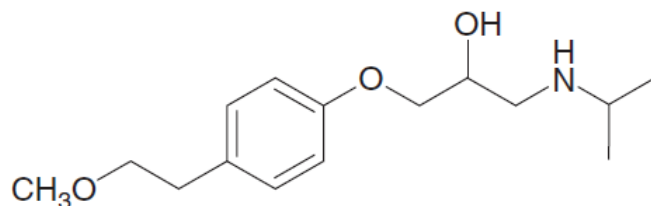


- Atom designated A has a hybridization of sp
 - Bond designated at B has bond overlap of two Csp³ orbitals
 - Atom designated at C is able to create resonance structures through its lone pairs
 - Atom designated at C has a bond angle of 109.5°
11. Given the following acid-base reaction, methoxide (⁻O-CH₃) can be characterized as a ___.



- a. Bronsted Acid
- b. Bronsted Base
- c. Lewis Acid
- d. Lewis Base
- e. More than one answer is correct

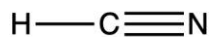
12. Which of the following is the **most** acidic hydrogen in metoprolol and why? (Hint: Element Effect)



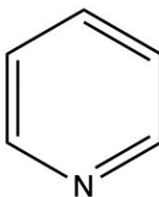
metoprolol
(used to treat high blood pressure)

- a. H attached to Oxygen; conjugate base is more stable
- b. H attached to Oxygen; conjugate base is less stable
- c. H attached to Nitrogen; conjugate base is more stable
- d. H attached to Nitrogen; conjugate base is less stable

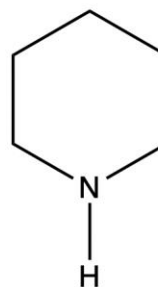
13. Which of the following compounds is most acidic?



A

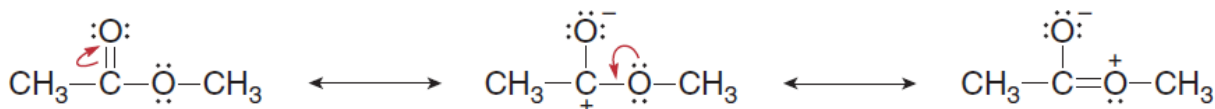


B



C

14. Which of the following statements regarding the resonance structures of methyl acetate is **false**? (two of answer choices on next page)



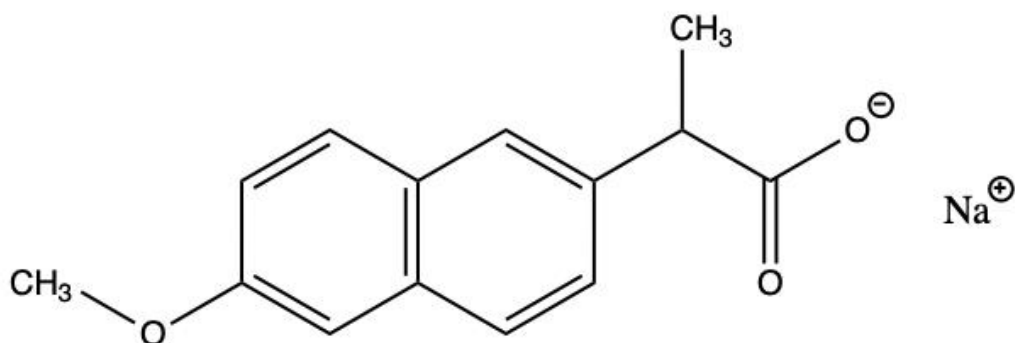
- Red arrows describe the *movement of electrons*
- Lone pairs on the right-most oxygen are delocalized from O p-orbital to the π^* (antibonding) orbital of the C-O molecular orbital
- The least-significant contributor to the resonance hybrid is the right-most structure
- The two C-O bonds will have a bond length in between a single and double bond.

Short Answer (4 Questions):

1. Answer the questions below regarding the structure of molecules and how they affect acidity.

- When comparing the acidity of two different acids, one must consider the stability of the conjugate bases using four factors—what are the four factors?
- Explain the effect of resonance and how it stabilizes the conjugate base.
- Explain what effect causes H-I to be more acidic than H-F and why.

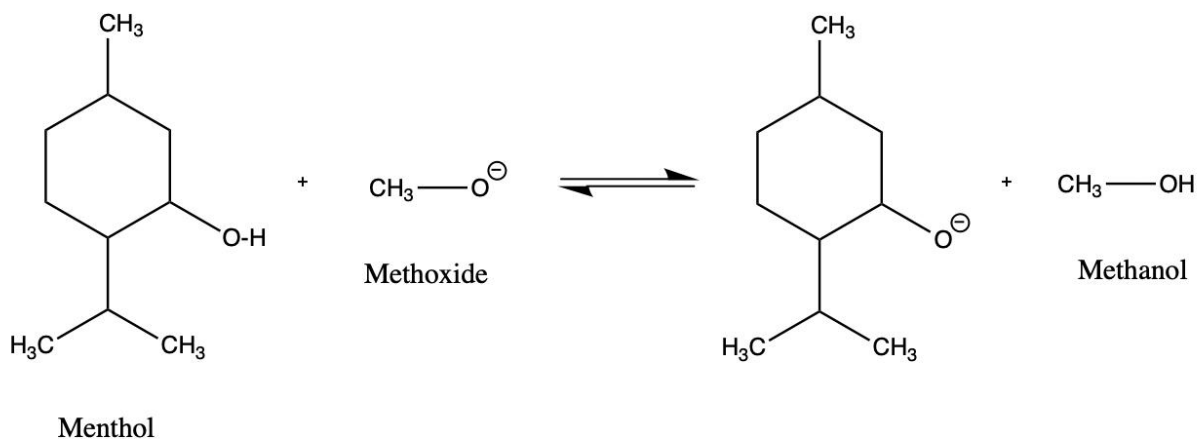
2. Naproxen sodium (generic for Aleve) is a nonsteroidal anti-inflammatory drug used for treating fever and pain. Answer the questions below regarding naproxen sodium.



Naproxen sodium

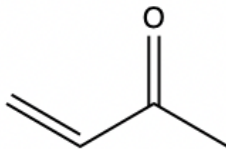
- What is the molecular formula of naproxen sodium (not including sodium)?
- Draw one resonance structure of naproxen sodium (not including sodium).
- How many sp^2 hybridized carbons are there?
- Draw one structural isomer of naproxen sodium.

3. Menthol is a chemical extracted from mint leaves and is used as a flavoring agent and in topical medication for its cooling sensation. Answer the questions below regarding the acid-base reaction.



- Draw all lone pairs on menthol and methoxide.
- Draw the curved arrow mechanism to show the flow of electrons in the reaction
- Label the conjugate acid and conjugate base of the reaction.
- Menthol has a pKa of 19 and methanol has a pKa of 15.7. Which side of the equilibrium will the reaction favor? Explain why.

4. The compound below is named 3-buten-2-one.



- Draw the resonance structures of 3-buten-2-one.

Organic Chemistry Peer Tutoring Department
Clever Chiu (cleverc@uci.edu)
Jason Lo (jslo1@uci.edu)
Daniel Lomboy (dlomboy@uci.edu)

CHEM 51A
Professor Dong
<https://sites.edu/ochemtutors>

- b. Label the hybridization of each carbon atom.
- c. Draw the resonance hybrid. Be sure to mark any atoms that have partial charges.