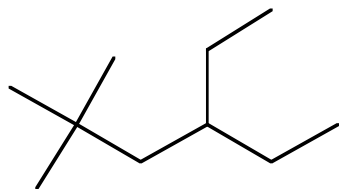


1) Provide names or structures as indicated below:

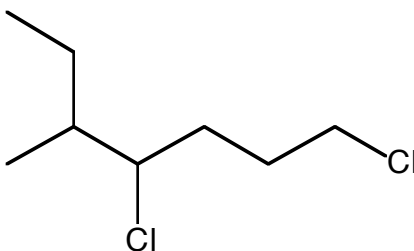
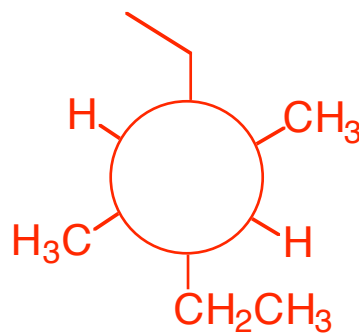
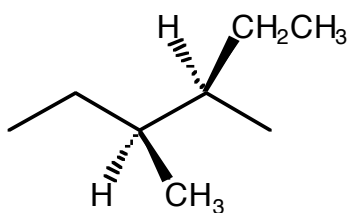
Condensed Structural Formula (6 points)



Name the molecule shown above (4 points)

4-ethyl-2,2-dimethylhexane

Draw the most stable **Newman Projection** of the molecule below viewed down the most appropriate bond. (6 points)



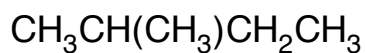
Provide a name (IUPAC or common) for the molecule shown above (6 points)

1,4-dichloro-5-methylheptane

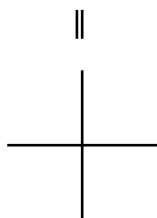
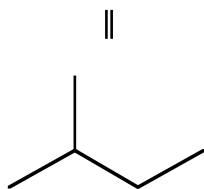
- 2) For each pair of molecules shown below, select the one that best fits the accompanying description by circling it. Provide a concise but thorough rationale for each of your decisions using pictures *and* words. (8 points each)

Rationale

The molecule with the highest boiling point?

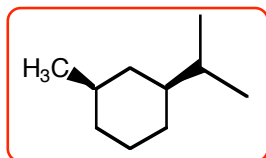


vs.

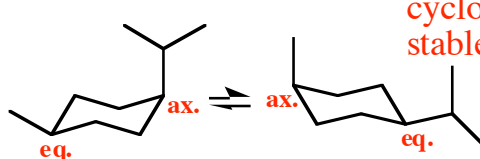
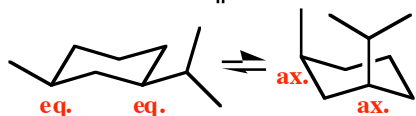
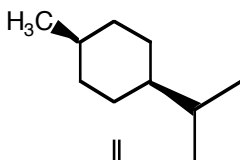


The correct answer has the least amount of branching, which exposes more surface area for van der Waals interactions. The more van der Waals interactions, the greater the attraction between molecules. The greater the attraction between molecules, the more energy (i.e. heat) it takes to boil them.

The lower energy molecule?



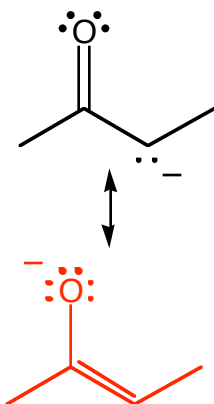
vs.



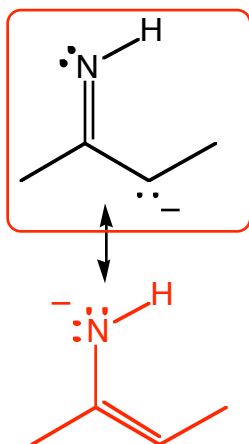
Axial substituents increase the energy of a cyclohexane ring because of the 1,3-diaxial steric interactions. Therefore, the fewer axial substituents that a cyclohexane possesses, the more stable it will be. Since cyclohexanes are in equilibrium with their

chair flipped conformers, the equilibrium will favor the more stable conformer. Thus, the molecule will take on the characteristics of the more stable conformer. Since one of the conformers has both alkyl groups in an equatorial position, that molecule will be the lowest in energy.

The strongest base?



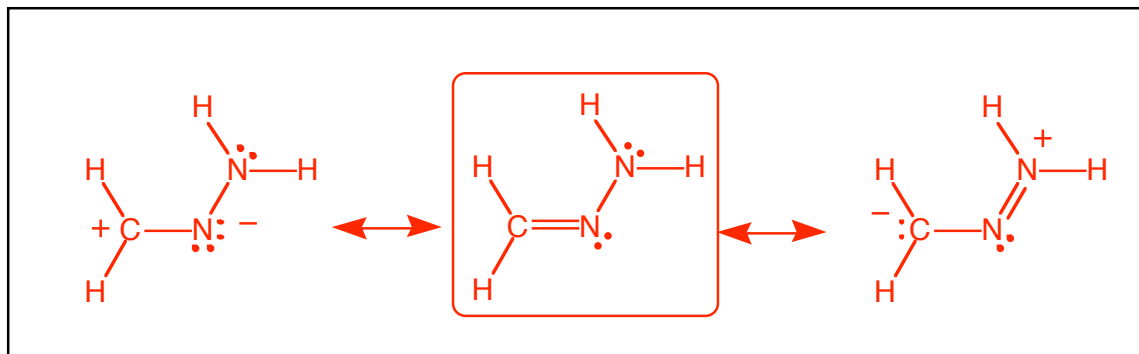
vs.



Both bases possess one resonance structure each. In the original structure, the charge is on carbon for both molecules. In the resonance structures, the charge is on a more electronegative atom than carbon. Therefore, the resonance picture is better suited for describing the stability of the molecule. The oxygen atom is more electronegative and thus better able to hold a negative charge. This makes the oxygen anion more stable than the nitrogen anion. Since the oxygen-containing base is more stable, it will be less reactive and thus less basic.

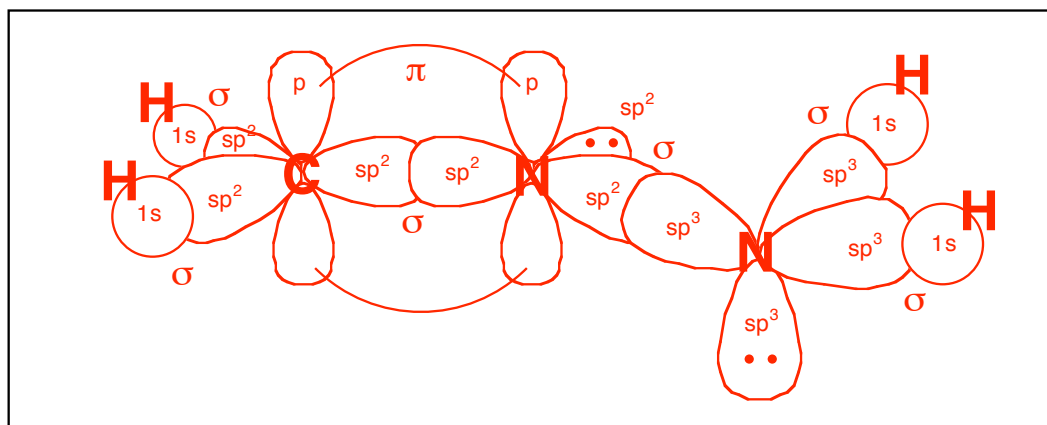
3) Draw all valid resonance structures (ones in which the overall net charge equals zero) for CH_2NNH_2 in the box provided. Then answer the questions that follow.

Resonance Structures for CH_2NNH_2 (8 points)



A) Circle the major contributor to the resonance hybrid. (4 points)

B) Draw the *orbital picture* for the major contributor in the box below. For full credit, label all orbitals, bond types, and bond angles. You will be judged on the 3-dimensional accuracy of your drawing. (8 points)



C) How many H-bond donor sites exist in the major resonance contributor? 2 (3 points)

D) How many H-bond acceptor sites exist in the major resonance contributor? 2 (3 points)

E) Which of the following descriptions apply to the major resonance contributor? Circle all that apply. (8 points)

i) contains a 1° carbon

ii) contains a 2° carbon

iii) contains a 3° carbon

iv) contains a methylene group

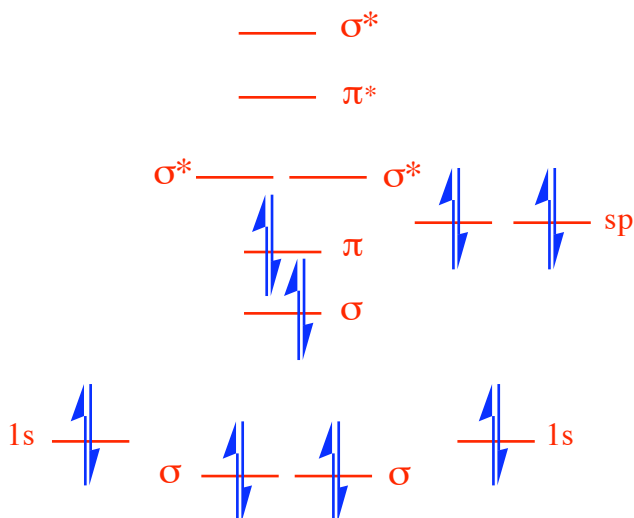
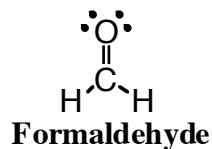
v) is insoluble in water

vi) is soluble in water

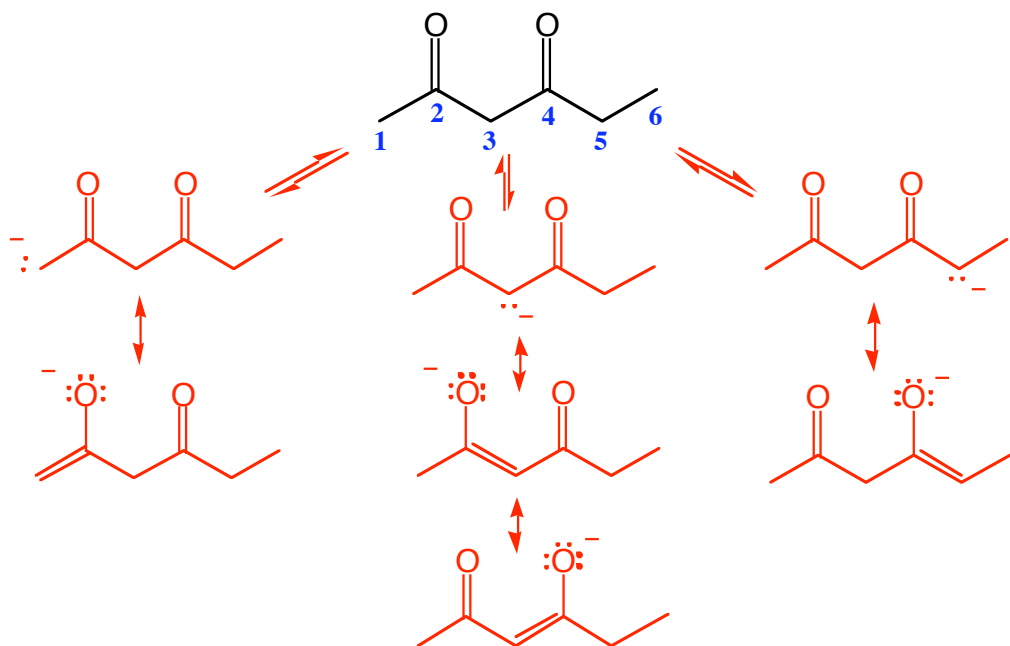
vii) can act as an acid

viii) can act as a base

- 4) Draw the MO energy diagram for formaldehyde. Be sure to label all orbitals (hybridized, atomic, and molecular). Place your *final MO picture* below. Do all work on the back of the previous page. (10 points)



- 5) Identify the most acidic proton(s) on the molecule below. Provide a rationale for your selection. Your rationale must use pictures and words to receive full credit. (10 points)



Resonance can help to delocalize charge in a molecule. The more resonance forms of a molecule, the greater the charge delocalization, and thus the greater stability. A more stable conjugate base helps to favor the conj. base side of an equilibrium. Therefore, the proton responsible for the more stable conj. base must be the most acidic. Of the 4 different types of protons, on 1,3, & 5 give conj. bases with resonance structures. The protons at carbon-3 give rise to the most charge delocalized ion and therefore are the most acidic.