1. (15 pts) Draw line structures (as the lowest-energy resonance structures) for the following compounds. **Include all lone pairs and indicate all formal charges** (unless the formal charge is zero). Indication regarding how to connect the atoms is present in the molecular formulas given below at left.

1a. $\text{S(CH}_3\text{)}_3^+$

![1a](image)

1b. $\text{OCHCHCH}_2(-)$

![1b](image)

1c. $\text{CH}_3\text{NO}_2$

![1c](image)

2a. (5 pts) Compute the degrees of unsaturation in $\text{C}_2\text{H}_4\text{O}$; show you work.

My answer for 2c: __DU = 2-4/2+1 ______

2bc (10 pts) Draw two isomers possessing molecular formula $\text{C}_2\text{H}_4\text{O}$.

![2b](image)  ![2c](image)

3. (10 pts) Think about the electron-based mechanism of molecular absorption of light. Question: Which should absorb light of lowest energy, saturated or unsaturated hydrocarbons and why?

My answer: **One or two sentences! No credit** without an explanation. ___________________

__Unsaturated hydrocarbons absorb lower energy light because the filled bonding and the empty antibonding orbitals are closer in energy than in saturated molecules because pi bonds overlap less efficiently than sigma.________________________
4a. (10 pts) Draw the Newman projection of 2,3-dimethylbutane in its most stable conformation.

![Newman projection of 2,3-dimethylbutane](image)

4b. (5 pts) The lowest-energy conformer of n-butane is 0.9 kcal/mol less in energy than the second lowest conformer. With this information you should be able to estimate the difference in energy between the structure you drew in 4a and the second lowest conformer of 2,3-dimethylbutane.

There are 3 gauche interactions in the next highest conformer whereas there are two in the lowest energy conformer of 2,3-dimethylbutane. Each is worth 0.9 kcal/mol so the answer is 0.9 kcal/mol.

5a. (10 pts) Name the following structure.

7a: _____3-ethyl-3-hexene__________________

5b. (10 pts) How many signals in the $^{13}$C NMR spectrum will the structure in 5a have?

Answer: 5a_8___ How many signals in 5b?__3__(5b)

6. (10 pts) In molecular formula C$_4$H$_4$O$_2$ Each carbon atom is connected to at least two and only two carbon atoms by single bonds. Draw a structure that maximizes the dipole moment and draw a structure that minimizes the dipole moment of the molecule.

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7. (15 pts) (5 pts) Rank the molecules according to stability. (10 pts.) Explain your answer for the most stable structure and the least stable structure (one or two words will be enough for each).

Most stable _D_, _B_, _A_, least stable _C_.

7. Most stable: __Most substituted__

Least stable _trans-double bond in a six-membered ring is strained_. Poor orbital overlap. _