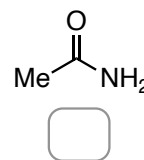
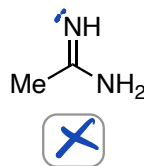
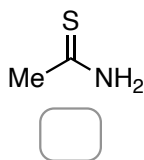
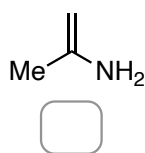
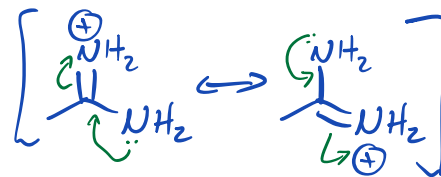


4 pts. 1a. Mark an **X** in the box corresponding to the compound that is most likely to accept a proton.

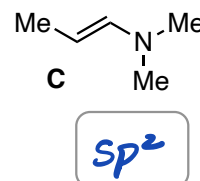
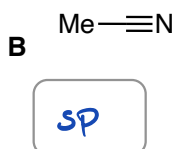
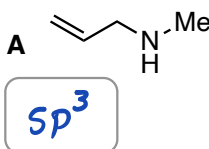


In the space below, provide an explanation for your selection. Include structures to aid your answer.

The conjugate acid is able to delocalize the charge over two nitrogens, as evident in the resonance structures. The other compounds do not exhibit such predominant resonance structures.



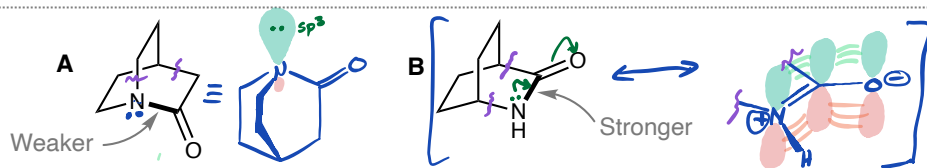
5 pts. 1b. What is the hybridization of the nitrogen in each of the compounds below?



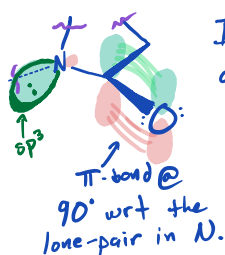
Compare compounds **A** and **C**. Which compound is more basic and why? Include structures to aid your answer.

Compound **A** is more basic because the nitrogen has less s-character. Cmpd **C** has a resonance structure where the lone-pair e⁻s are delocalized, thus leading to sp² hybridization, making the lone-pair e⁻s less available to accept a proton.

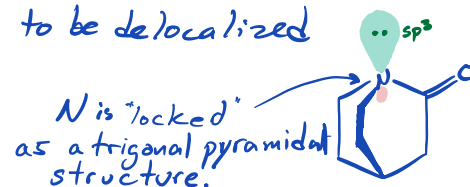
5 pts. 1c. Consider the structures below. The **C-N bond** in **bold** is much stronger in **B** than in **A**. Provide the most reasonable explanation. Include structures to aid your answer.



The C-N bond in **B** is stronger because the lone-pair e⁻s can participate in resonance. the p-orbital in nitrogen is in the same plane as the C=O π-bond. Therefore, the C-N bond exhibits double-bond character (stronger bond).



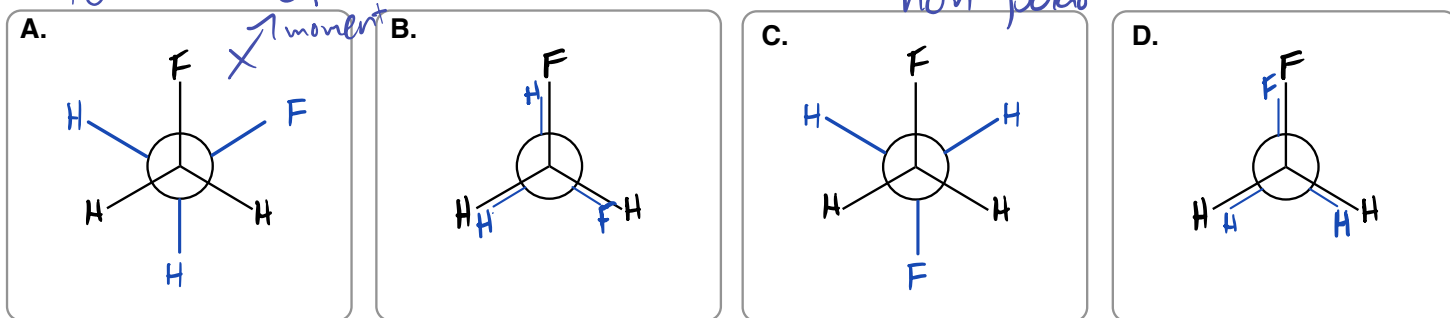
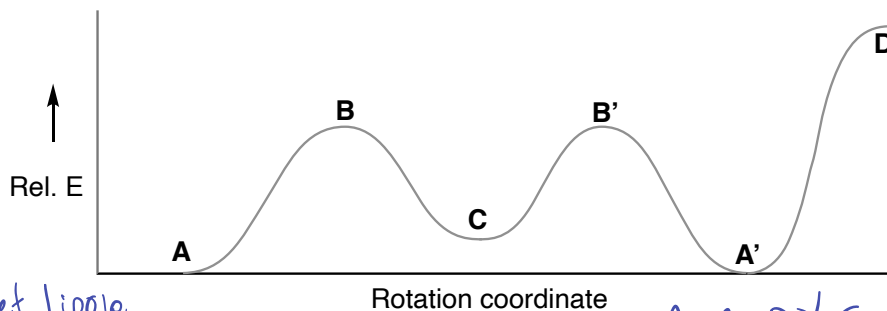
In cmpd **A**, however, the lone-pair e⁻s are orthogonal to the C=O π bond, and cannot participate in resonance. The N is "locked" and can't adopt a trigonal planar structure to allow its e⁻s to be delocalized along the plane of the π bond.



pts. this pg.

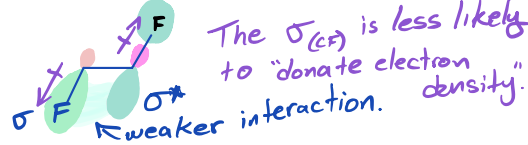
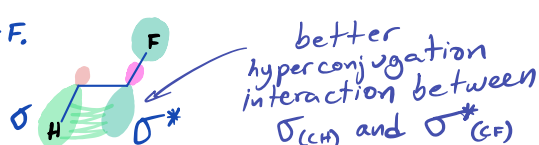
The compound 1,2-difluoroethane would appear to be a non-polar molecule. However, it has been found that it is indeed a polar molecule, which means that the **most stable rotamer is polar**.

8 pts. 2a. Draw the **Newman projections** of each conformational isomer of 1,2-difluoroethane, as viewed from carbon-1 (C1) toward C2 in the back. The free-energy diagram shows each energy minima and maxima as the dihedral angle changes, rotating through the C-C bond. Each label represents a rotation of 30°. In the box provided **draw the structure that corresponds to each point**. You do not have to draw the structures for A' and B' since their energy is the same as A and B, respectively.



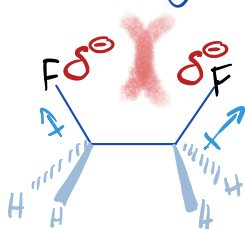
4 pts. 2b. Why is **A** lower in energy than **C**? Provide the most reasonable explanation below.

The C-F bond is more polar than a C-H bond. It can be reasoned that comparing both types of bonds, the σ C-H bond is more "electron rich." Therefore, stabilization by hyperconjugation in A is more favored than in C; i.e. the C-H σ bond provides more stability to the σ^* C-F.

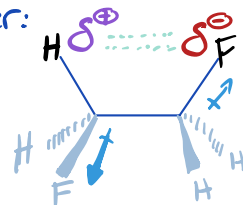


4 pts. 2c. Why is **B** lower in energy than **D**? Provide the most reasonable explanation below.

Structure **D** is greater in energy than **B** since two very polar bonds are eclipsing each other, leading to the unfavorable electrostatic interactions.



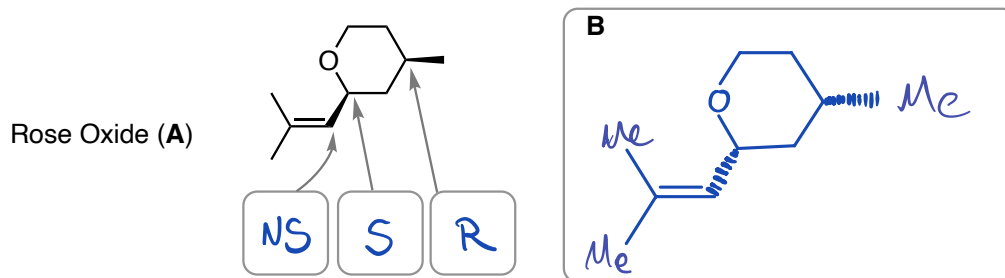
a C-H eclipsing C-F is better:



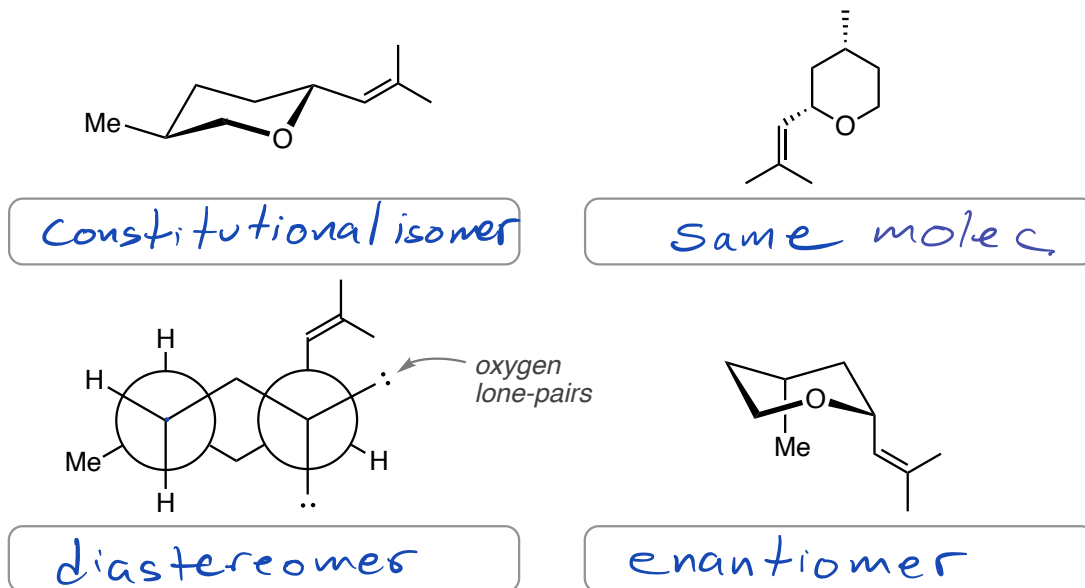
Name: _____

Valentine's day small talk: The natural product shown below is *rose oxide*. The stereoisomer **A** and its enantiomer **B** are responsible for the smell in roses. The other two stereoisomers are not as easily detectable by your nose.

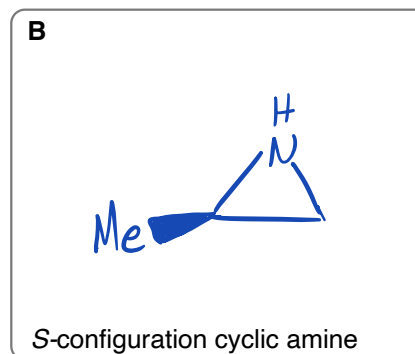
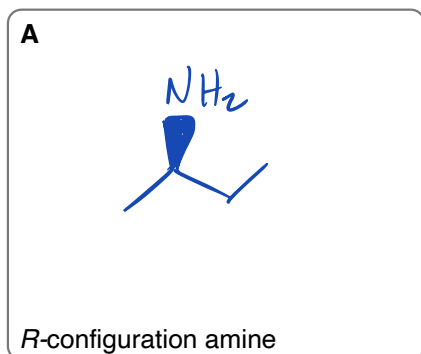
6 pts. 3a. Label the **specific configuration** of each stereocenter. If **not a stereocenter**, write: **NS**. Then, draw the line/wedge structure of its enantiomer **B**.



8 pts. 3b. Indicate the **relationship** between the rose oxide (**A**) structure above & the molecules below as: **same molecule**, **diastereomer**, **constitutional isomer**, **enantiomer**, **meso compound**, or **not isomers**.



8 pts. 3c. In **A** (below), draw the **line/wedge** structure of the **R-configuration** of the smallest **chiral alkylamine** and provide its name. In **B** (below), draw the **S-configuration** of the smallest **chiral cycloalkylamine**. (smallest = least number of atoms.)



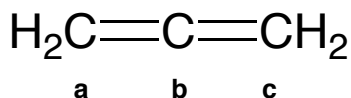
Name:

(R)-2-butanamine

or (R)-butan-2-amine

Name: _____

Consider the C_3H_4 isomer shown below (propa-1,2-diene), which is part of a hydrocarbon family called *allenes*. Note that the carbons contain a label, **a**, **b**, and **c**.



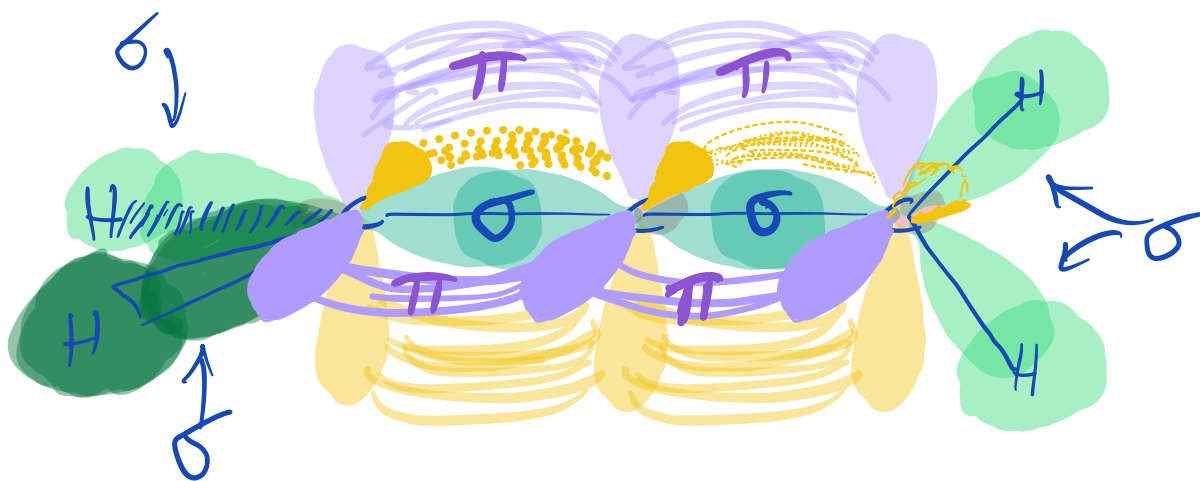
2 pts. 4a. What is the hybridization of carbon **a**?

a sp^2

2 pts. 4b. What is the hybridization of carbon **b**?

b sp

8 pts. 4c. Draw the molecular orbital picture (the orbitals on the molecule, not the MO diagram) of propa-1,2-diene and label all molecular σ and π bonds, in addition to any non-bonding atomic orbitals (s, p, etc.), if any.



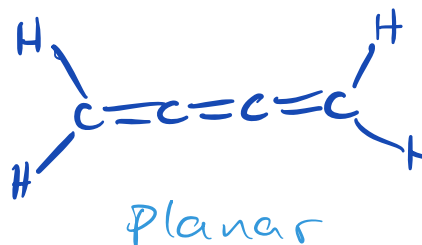
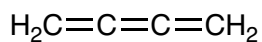
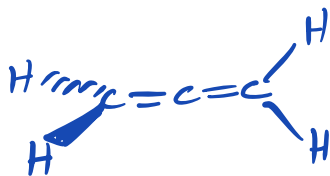
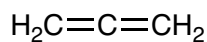
2 pts. 4d. How many sp^2 orbitals are engaged in forming σ bonds?

6

2 pts. 4e. 2 pts. What is the dihedral angle between H-C(a)-C(c)-H in propa-1,2-diene?

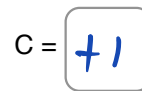
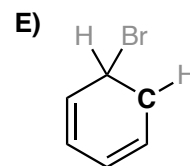
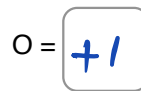
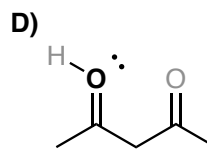
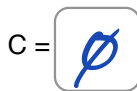
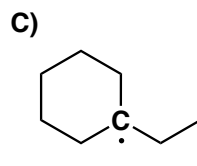
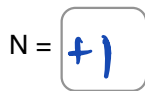
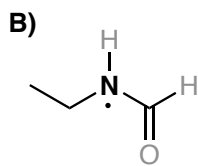
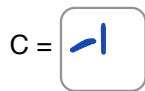
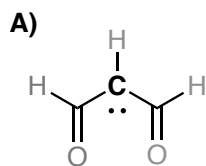
90°

6 pts. 4f. In the boxes below, **using line formula**, adopting **dashes** and **wedges**, draw the molecular representation that best describes the three-dimensional shape of each of the allenes below.



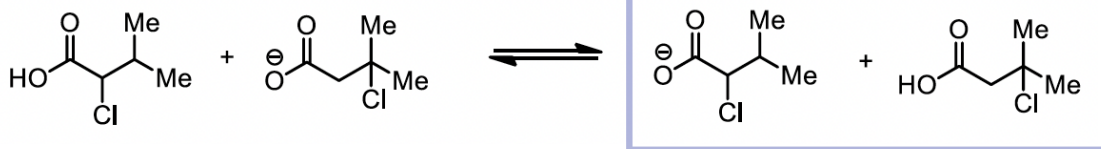
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5 pts. 5a. Gen Chem Flashback: For each of the **LINE-LEWIS DOT** structures below, provide the **FORMAL CHARGE of the atoms in bold**. The presence and absence of single electrons, lone-pair electrons and bonding electrons have been indicated with dots and lines about each atom.

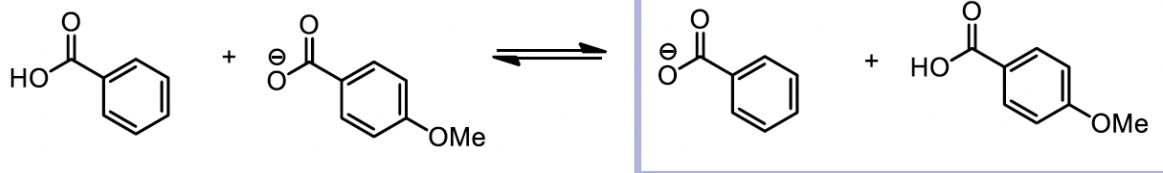


12 pts. 5b. Circle the **side of the equilibrium** that is **FAVORED** in each reaction, *i.e.* the side with the weakest conjugate acid/base combination.

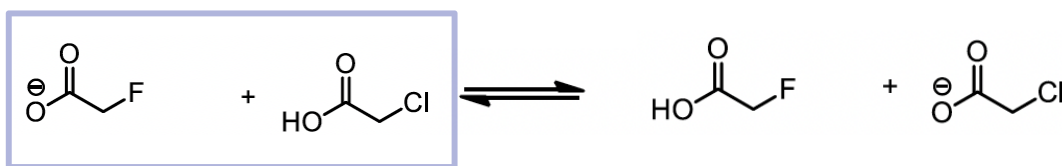
A)



B)



C)



D)

