Academic Honesty Policy. Academic honesty is strictly enforced on quizzes, exams, and other aspects of this course. Academic dishonesty will result in a failing grade in the class and a letter in the student's file. Activities constituting academic dishonesty include:

Cheating
- Copying from others during an examination.
- Communicating exam answers with other students during an examination.
- Offering another person's work as one's own.
- Taking an examination for another student or having someone take an examination for oneself.
- Tampering with an examination after it has been corrected, then returning it for more credit.
- Using unauthorized materials, prepared answers, written notes, or concealed information during an examination.

Dishonest Conduct
- Stealing or attempting to steal an examination or answer key from the instructor.
- Allowing another student to copy off of one's own work during a test.

Collusion
- Any student who knowingly or intentionally helps another student perform any of the above acts is subject to discipline for academic dishonesty.

I understand and will abide by this academic honesty policy: ____________________________ (signature)

Seat: _______
1. (4 points each, 24 points)

a. Rank the following in order of increasing acidity: _____ < _____ < _____
   
   A. CH₃CH₂CH₂CO₂H
   B. CH₃CH₂CH₂NH₃⁺
   C. CH₃CH₂CH₂SO₃H

b. Rank the following in order of increasing basicity: _____ < _____ < _____
   
   A. methyl lithium
   B. methylamine
   C. acetone

c. Rank the following in order of increasing reactivity toward HCN: _____ < _____ < _____
   
   A. 2-butanone
   B. diethyl ether
   C. butanal

d. Rank the following in order of increasing nucleophilicity: _____ < _____ < _____
   
   A. CH₃MgBr
   B. CH₃OH
   C. CH₃NH₂

e. Rank the following in order of increasing boiling point: _____ < _____ < _____
   
   A. propanoic acid
   B. 1-butanol
   C. pentane

f. Rank the following in order of increasing oxidation state of carbon: _____ < _____ < _____
   
   A. formaldehyde
   B. formic acid
   C. methanol
2. Infrared, $^{13}$C NMR, and $^1$H NMR spectra are shown for a compound with a molecular formula C$_5$H$_{10}$O$_2$ are shown below. Write the structure of the compound in the box. (16 points, Adapted from Smith 19.62)
3. Hemiaminal ethers can form by the acid-catalyzed reaction of imines and alcohols. Write a curved-arrow mechanism for the acid-catalyzed reaction of methanol with an imine to form the corresponding hemiaminal methyl ether. Make sure to show each step of the reaction and all reactants, intermediates, products, charges, and lone pairs of electrons (18 pts).

\[
\text{an imine} \xrightarrow{\text{CH}_3\text{OH}^+ \text{ (cat.)}} \text{CH}_3\text{O}^- \text{NH} \quad \text{CH}_3\text{OH} \text{ (solvent)} \rightarrow \text{a hemiaminal ether}
\]

4. Aldehydes form bisulfite addition products reversibly upon treatment with sodium bisulfite (NaHSO₃). These adducts break down upon treatment with acid or base in water. Write a curved-arrow mechanism for the breakdown of the bisulfite adduct of benzaldehyde by sodium hydroxide. (12 pts).

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\text{bisulfite adduct of benzaldehyde} \quad \xrightarrow{\text{H}_2\text{O}} \text{H}^- \quad \xrightarrow{\text{H}_2\text{O}} \text{H}^+ \quad \text{SO}_3^{2-} \quad \text{H}_2\text{O}
\]
5. Design good syntheses of the following compound starting with compounds containing **six carbon atoms or fewer** as the only organic starting materials. You may use any other inorganic reagents you choose and organic reagents that don't get incorporated into the final product, such as TBDMSCl, Ph₃P, LDA, PCC, DCC, p-TsOH, TsCl, etc.

SELECT FIVE (5) OF THE FOLLOWING SIX (6). (6 POINTS EACH, 30 POINTS TOTAL). CROSS OUT THE ONE (1) THAT YOU DO NOT WISH TO ANSWER, OR ONLY THE FIRST FIVE PROBLEMS WILL BE GRADED.

a. 

![Image of compound a.](image)

b. 

![Image of compound b.](image)

c. 

![Image of compound c.](image)
d.

\[ \text{Structure Image} \]

e.

\[ \text{Structure Image} \]

f.

\[ \text{Structure Image} \]

PLEASE REVIEW THE ACADEMIC HONESTY STATEMENT ON PAGE 1 AND SIGN IT IF YOU ARE ABLE