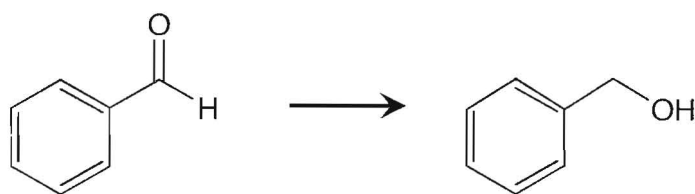


NAME _____

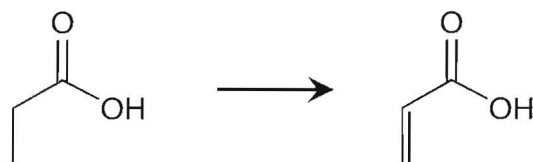
Scoring: 1. _____ / 9 4. _____ / 16
2. _____ / 15 5. _____ / 12
3. _____ / 20 6. _____ / 28

Total Score: _____ / 100

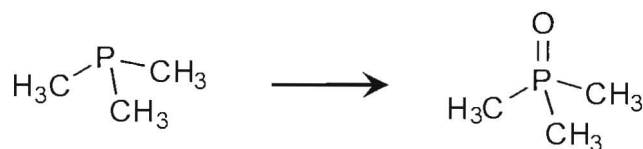
1. (9 pts) Identify each of the transformations below as a reduction, an oxidation, or neither.
Circle only one answer for each transformation.



REDUCTION (3)
or
OXIDATION
or
NEITHER

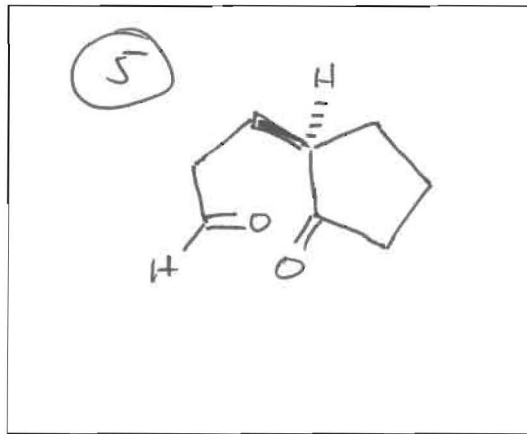
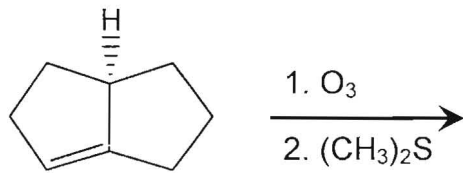


REDUCTION
or
OXIDATION (3)
or
NEITHER



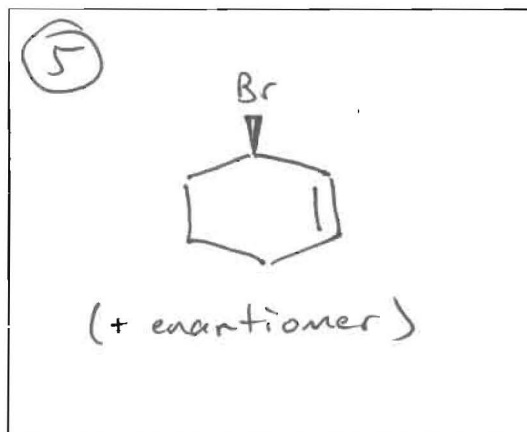
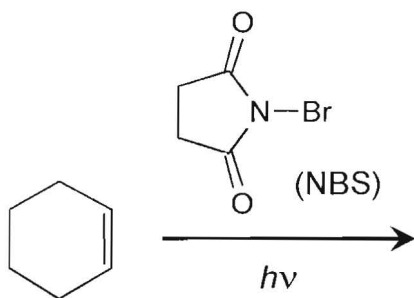
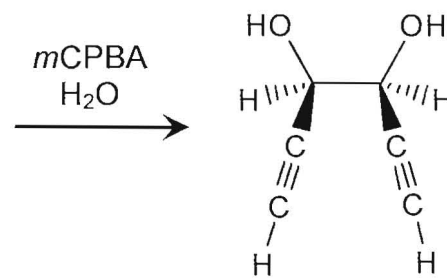
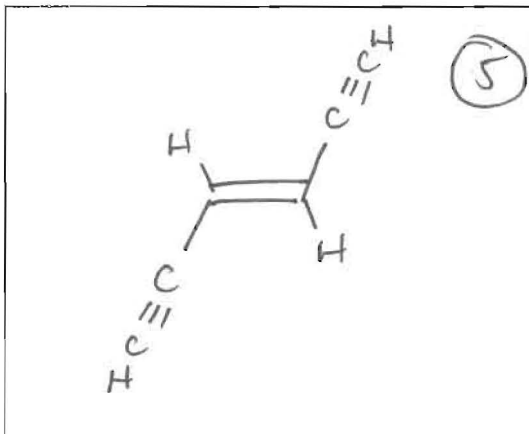
REDUCTION
or
OXIDATION (3)
or
NEITHER

2. (15 pts) For each of the reactions below, fill in the empty box corresponding to reactants or products. For reactions that you expect to yield multiple products, give the major product. For reactions that yield multiple enantiomers, draw only one enantiomer in the box, and include the note "+ enantiomer".



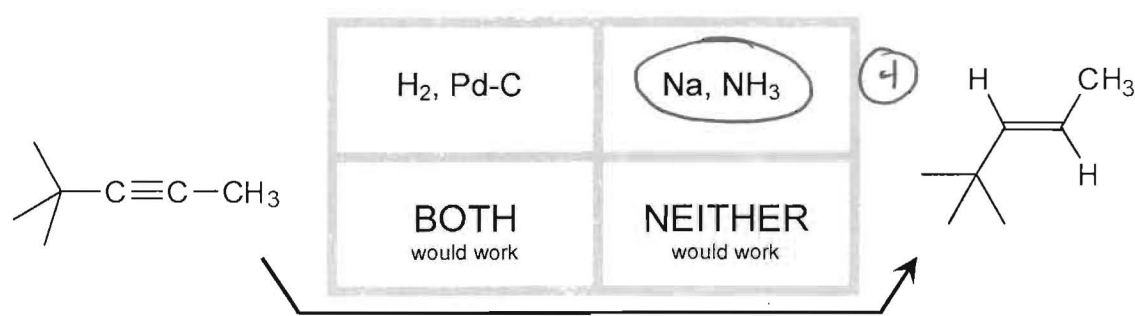
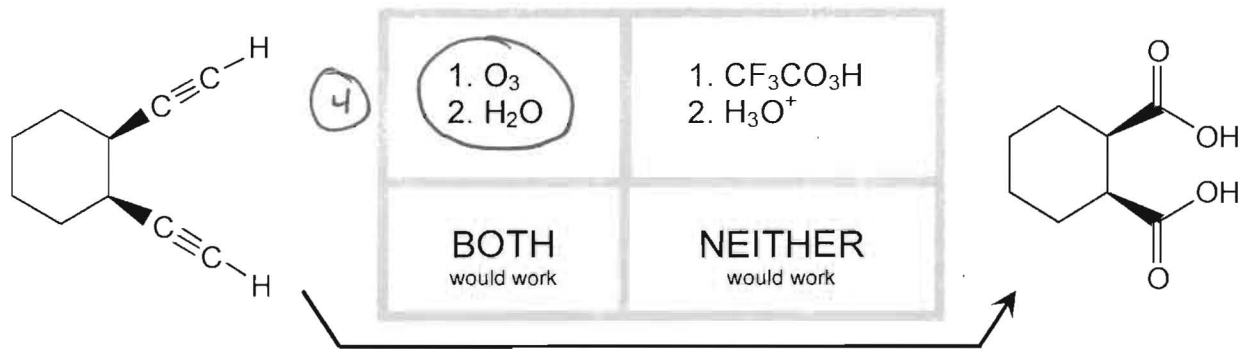
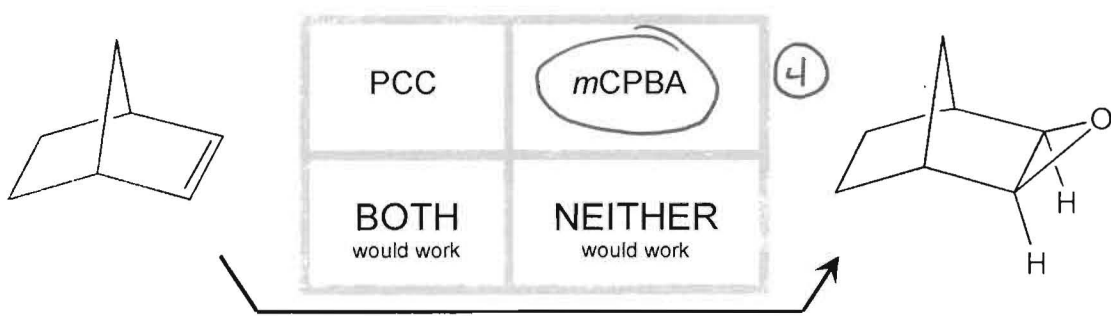
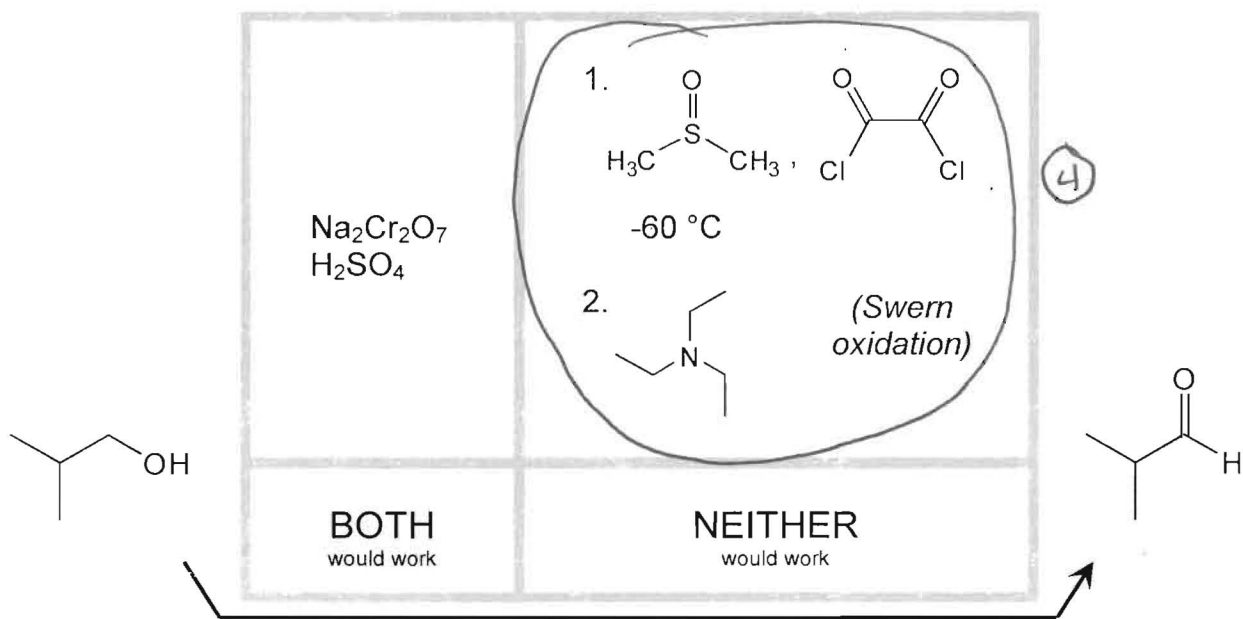
2 for any product w/ cleaved double bond & carbonyls instead.
4 for not showing stereochem,

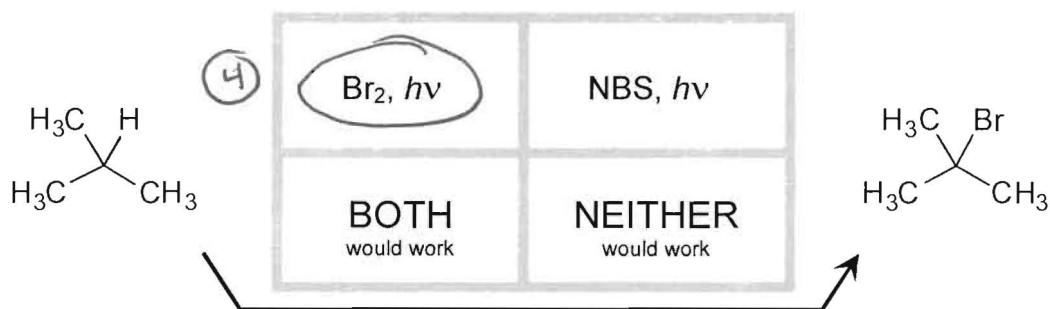
3 for cis-alkene



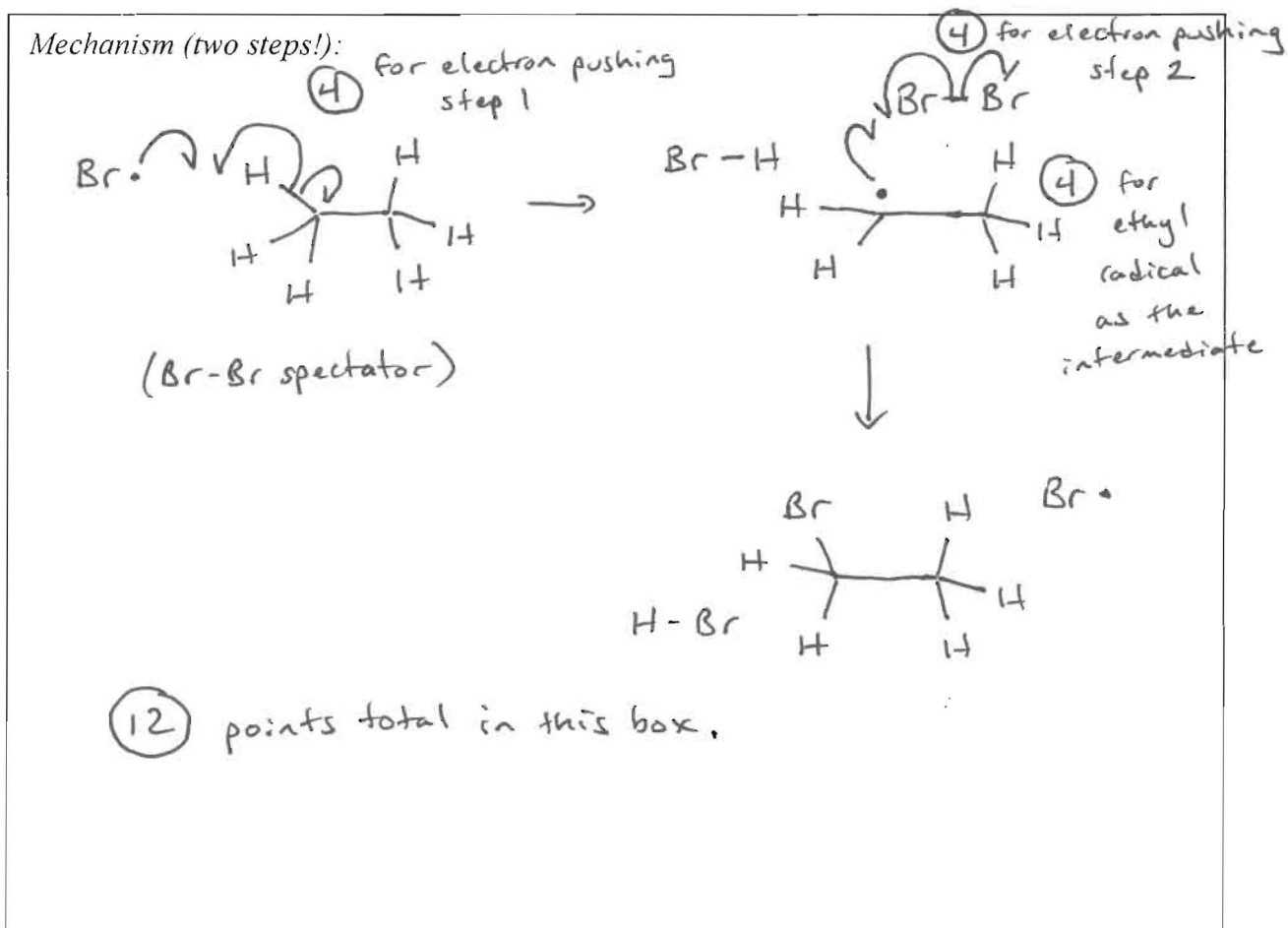
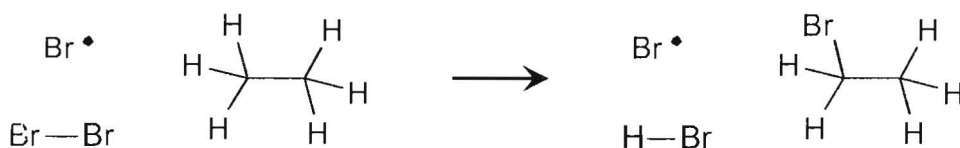
4 for not showing stereochem or omitting ("+ enantiomer")
2 for any other brominated product

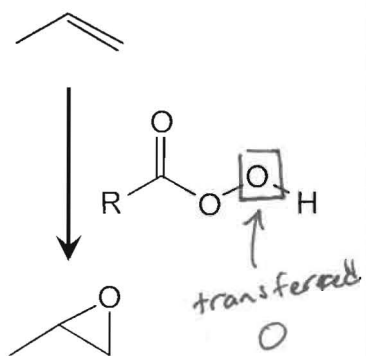
3. (20 pts) Each of the reactions on the next two pages is drawn with two possible reaction conditions. If only one of the two reaction conditions would generate the given molecule as the major product, circle those conditions. If both sets of conditions would accomplish the reaction, circle "BOTH". If neither set of reaction conditions would succeed, circle "NEITHER". Circle one answer only.



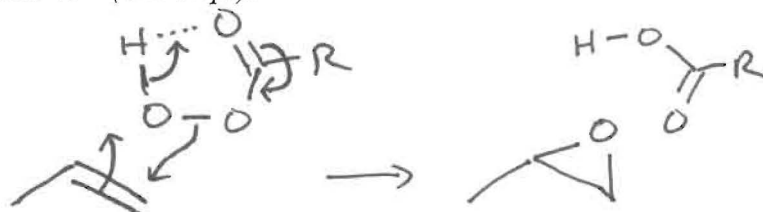


4. (16 pts) Draw a mechanism (using “electron pushing”) for each of the reactions shown below. Draw each mechanistic step explicitly; don’t cheat by combining multiple processes in a single step. Use only the molecules shown in the problem; don’t invoke generic species. (E.g., don’t use “R•” as a generic radical.)



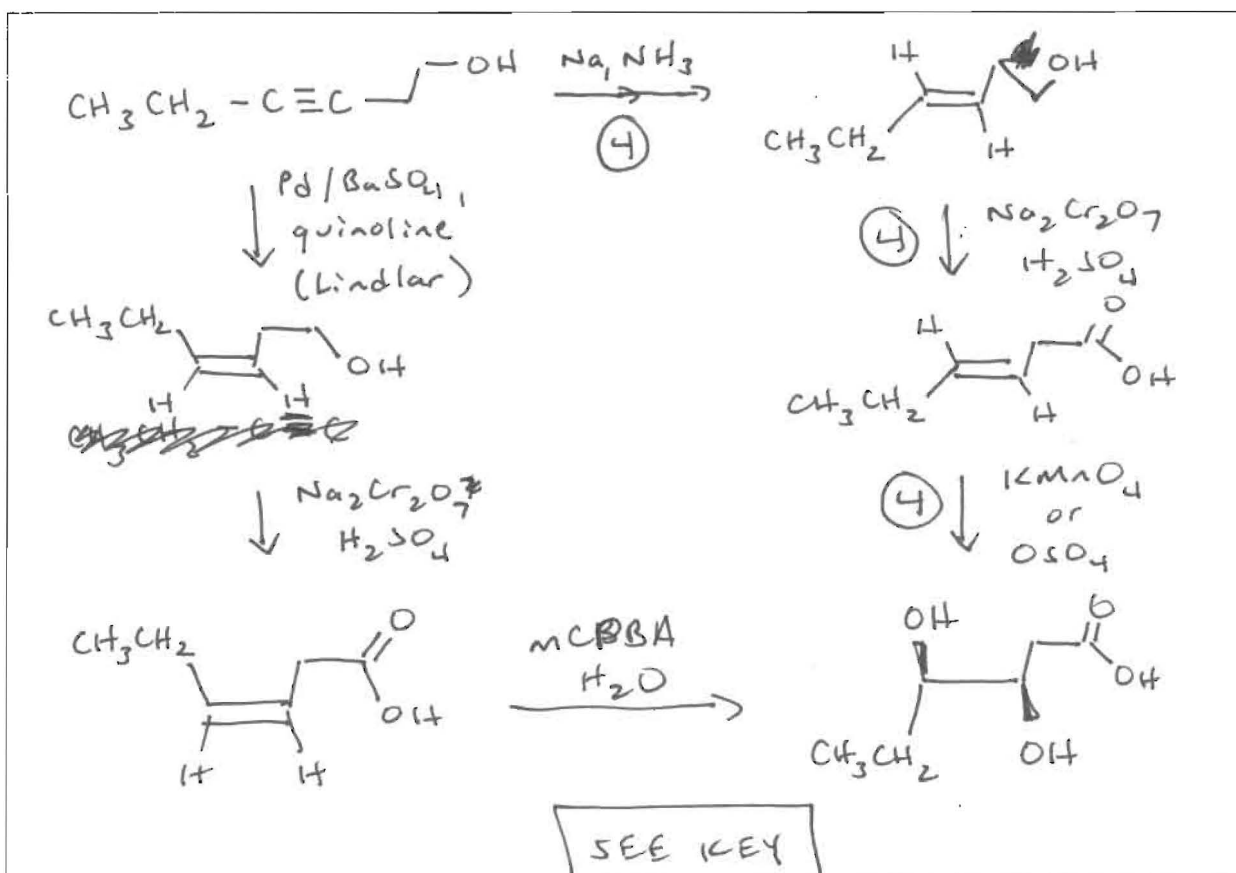
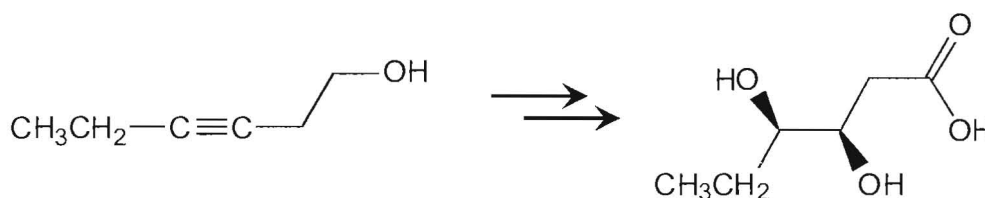


Mechanism (one step!):

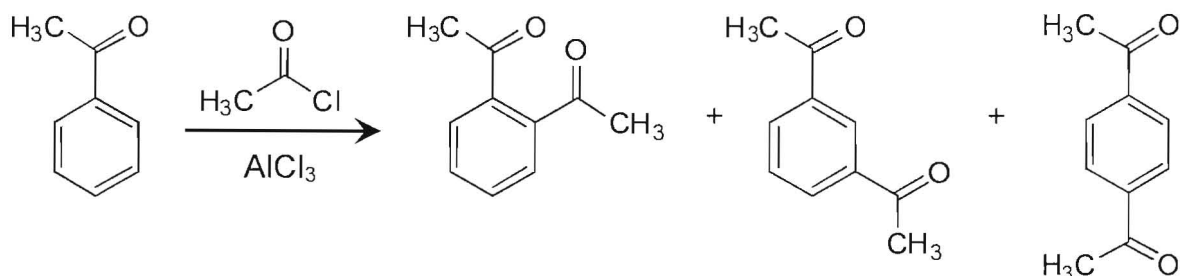


(4) Doesn't matter how you push arrows, as long as electrons get where they need to go.

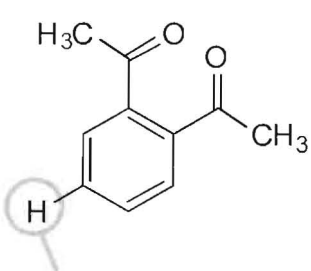
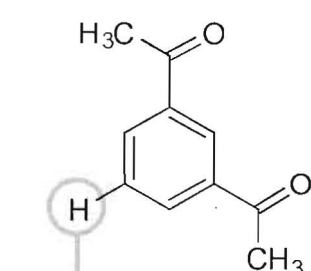
5. (12 pts) Propose a multistep synthesis of the product shown below from the given starting materials, along with any reagents we have covered in class. You might discover multiple answers to this problem; draw only your best (one) synthetic route. Feel free to draw an incomplete route—we will give you partial credit where we can.



6. (28 pts) When acetylbenzene is combined with acetyl chloride and a Lewis acid catalyst—in a reaction that you will learn about in CHEM 2302—three different diacetylbenzenes are generated as products. In this problem, you will imagine that you are a chemist that has performed this reaction, and that you have isolated one of the three products. You have performed ^1H and ^{13}C NMR spectra on this product, shown on page 9. In the questions that follow, you will decide which of the three products you have isolated.



- (a) How many resonances would you expect to see in the ^1H NMR of each of these products? In other words, how many inequivalent sets of protons are there in each structure? Write your answers in the boxes below.

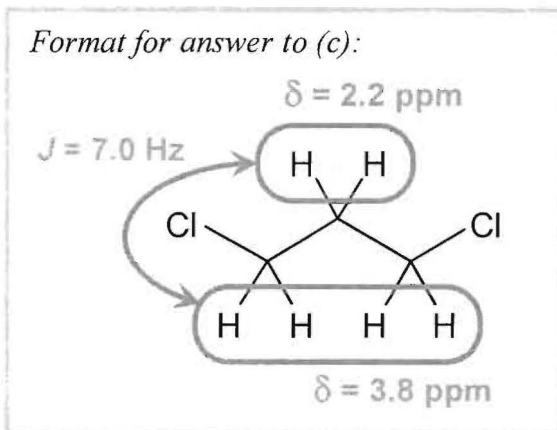
# ^1H NMR resonances expected	<div style="border: 1px solid black; width: 60px; height: 60px; display: flex; align-items: center; justify-content: center; margin: 0 auto;"> 3 </div> <div style="text-align: right; margin-right: 5px;">(2)</div>	<div style="border: 1px solid black; width: 60px; height: 60px; display: flex; align-items: center; justify-content: center; margin: 0 auto;"> 4 </div> <div style="text-align: right; margin-right: 5px;">(2)</div>	<div style="border: 1px solid black; width: 60px; height: 60px; display: flex; align-items: center; justify-content: center; margin: 0 auto;"> 2 </div> <div style="text-align: right; margin-right: 5px;">(2)</div>
	type of multiplet for this proton	 <div style="border: 1px solid black; width: 60px; height: 60px; display: flex; align-items: center; justify-content: center; margin: 0 auto;"> d </div> <div style="text-align: right; margin-right: 5px;">(2)</div>	 <div style="border: 1px solid black; width: 60px; height: 60px; display: flex; align-items: center; justify-content: center; margin: 0 auto;"> + </div> <div style="text-align: right; margin-right: 5px;">(2)</div>

- (b) Each proton highlighted in the structures above could be split by neighboring protons. What kind of multiplet should each proton produce in a ^1H NMR spectrum? (Assume that there is no long-range coupling for the circled proton. But there might be for the others!) Use the abbreviations on the chart on the right, and write your answers in the boxes above.

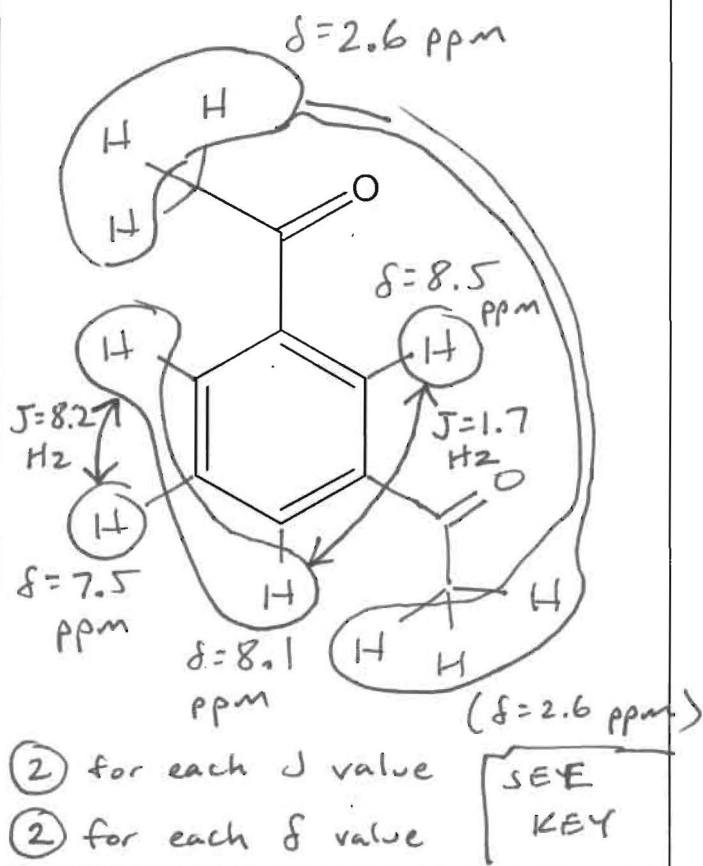
abbreviations for multiplets

s: singlet
 d: doublet
 t: triplet
 q: quartet
 dd: doublet of doublets

12 total



Your answer to (c):



(c) ^1H and ^{13}C spectra for the isolated molecule are shown on the next page. Which of the three products did you isolate? On the unfinished skeleton in the box at right, indicate your choice by drawing in any appropriate functional groups, as well as all hydrogens. Then,

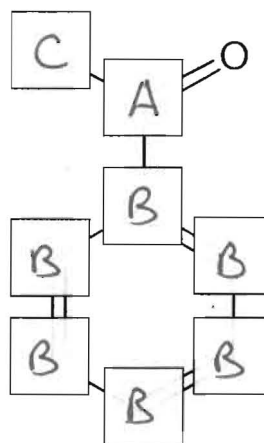
- Circle each group of equivalent H's;
- Assign a ^1H chemical shift (δ) to each circled group, within 0.1 ppm;
- Connect any pair of coupled, inequivalent groups of H's with a double-headed arrow, and then label that arrow with the corresponding coupling constant (J).

② for each J value
② for each δ value

SEE
KEY

↳ ① PARTIAL FOR MIXING UP AROMATIC δ VALUES;
① FOR CORRECT δ , BUT INCORRECT CIRCLE.

(d) The ^{13}C NMR spectrum of the isolated product showed 6 peaks, which appear in three distinct regions of the spectrum. I've labeled these regions **A**, **B** and **C** on the ^{13}C spectrum on the next page. As you did above, re-draw your proposed contaminant structure below (though this time you can omit H's). Then, in each empty box, write the letter **A**, **B**, or **C** to indicate the region of the ^{13}C NMR you would expect to find that carbon resonance. **Fill all boxes.**



A: ①
B's: ②
① if any correct,
C: ①

(DOESN'T MATTER WHAT ELSE WAS DRAWN-)