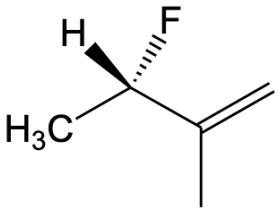
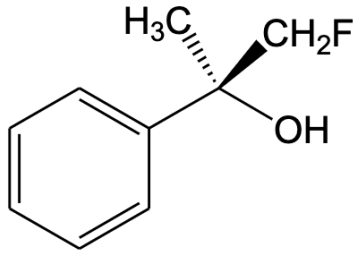
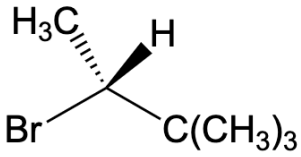
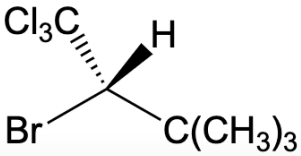
1. Assign R/S centers.

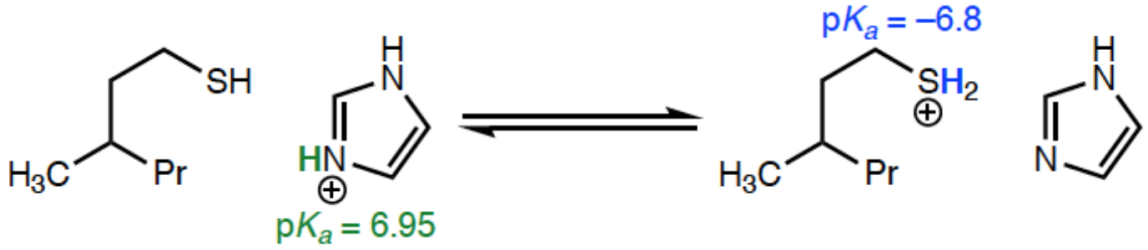
(1) 

(2) 

(3) 

(4) 

2. Identify whether the acid-base equilibrium lies to the **left or to the right** in the reactions below. (2 pts each)

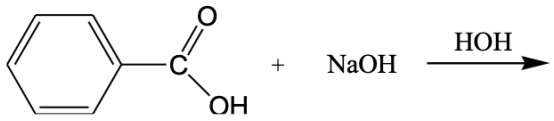


left right

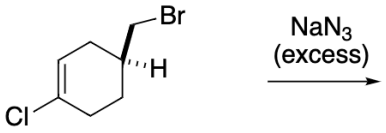
3. What is the index of hydrogen deficiency of a compound with a molecular formula of $C_9H_{11}NO$?

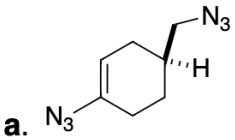
(a) **3** (b) **4** (c) **5** (d) **6**

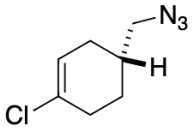
Complete the following acid-base reaction (write the products).

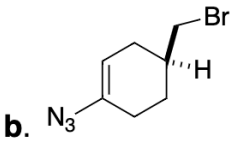
(4) 

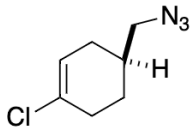
5. Azide anion is a very good nucleophile. Predict the major product from the following reaction?



a. 

c. 

b. 

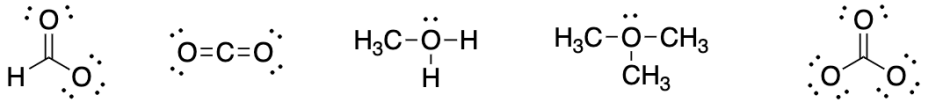
d. 

6.

Which of the following would react most quickly in an S_N1 reaction with acetic acid?

a. methyl fluoride
b. ethyl chloride
c. isopropyl chloride
d. tert-butyl bromide

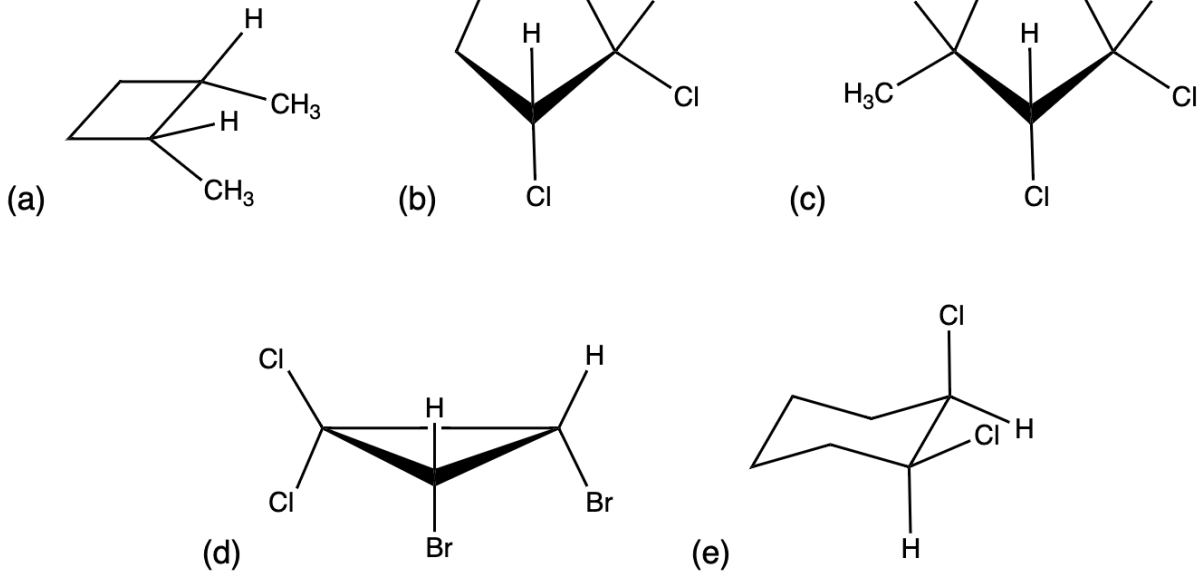
7. Which structure(s) contain(s) an oxygen that bears a **formal charge of +1**?



I **II** **III** **IV** **V**

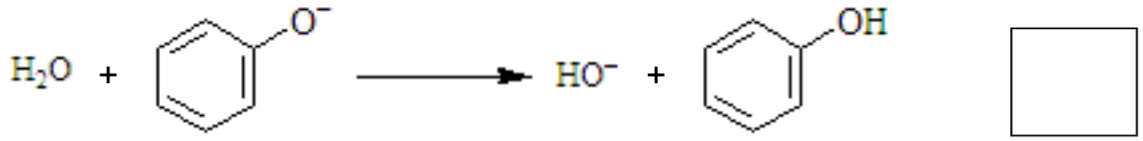
(a) **I** and **II**
(b) **III** and **IV**
(c) **V**
(d) **III**
(e) **I** and **V**

10. Which compounds is **not** a meso compound?



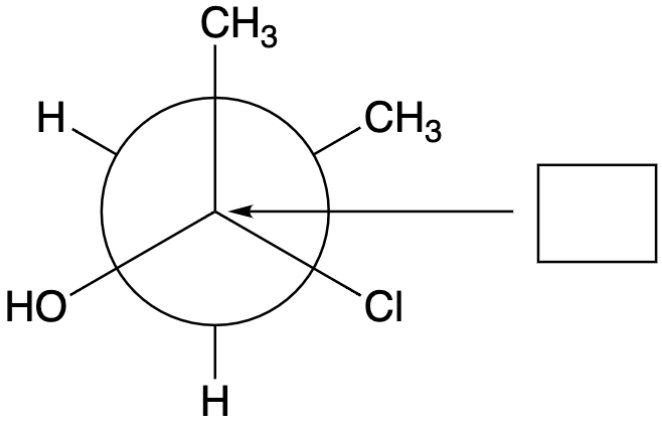
True or False:

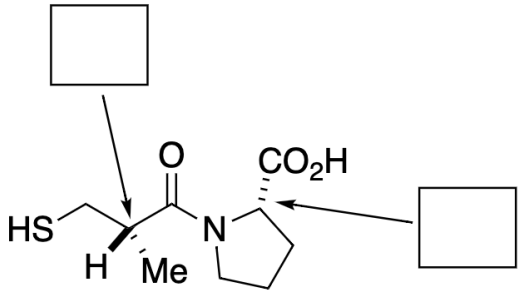
12. The given reaction should be favorable based on the pKa values shown.



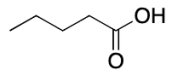
pKa=15.7 pKa=9.9

12. For each of the indicated chiral centers below, provide the correct R or S designation. (6 pts)

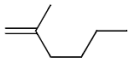




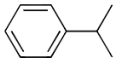
12. Match each compound to its IR spectrum. (12 pts)



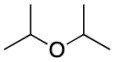
A



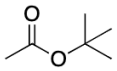
B



C

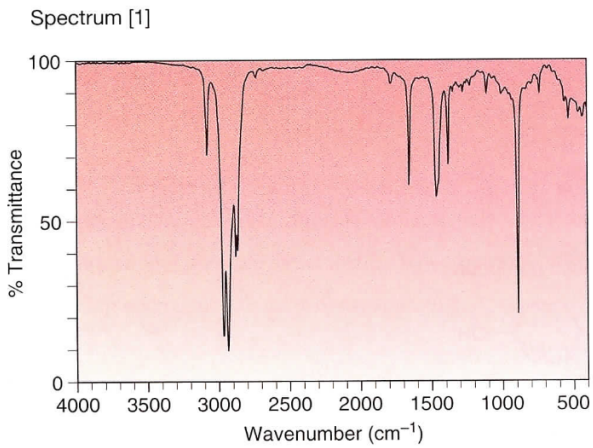


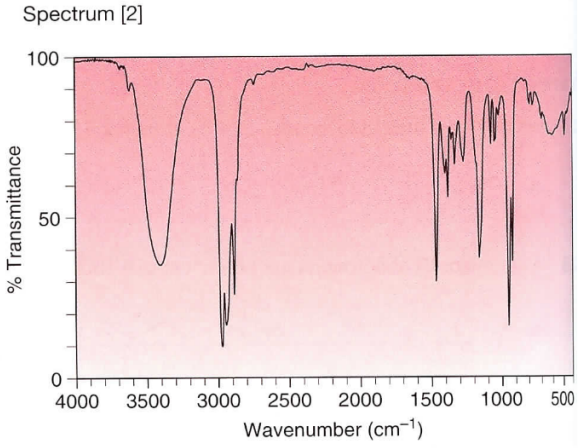
D

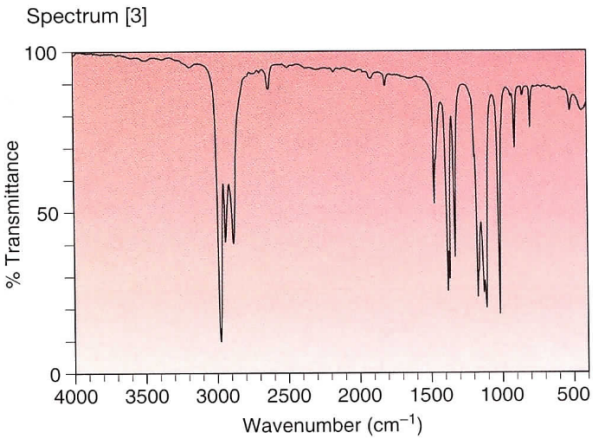


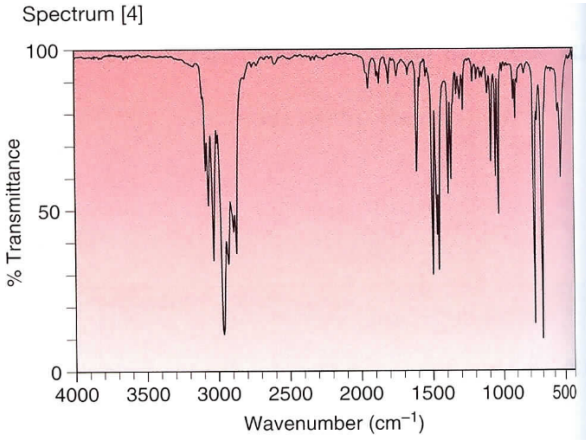
E

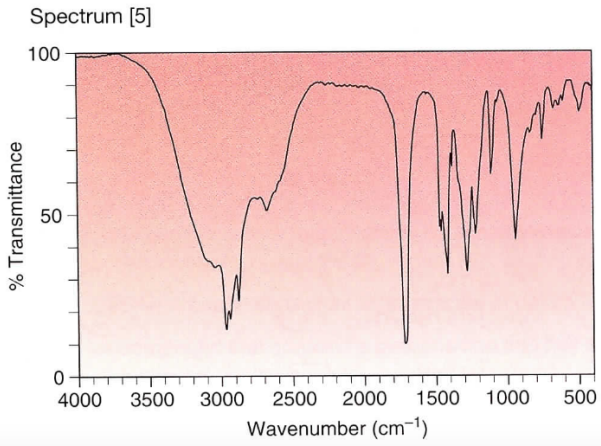
F

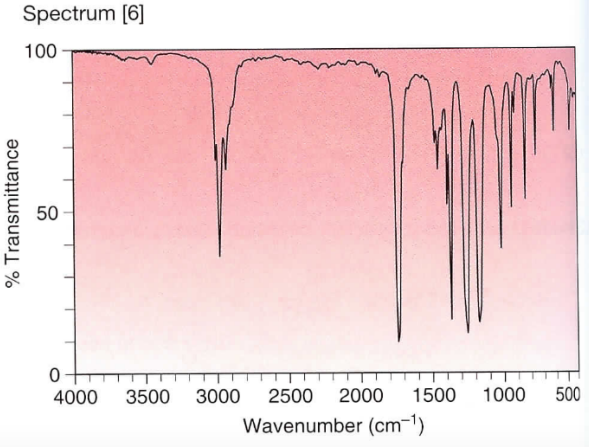










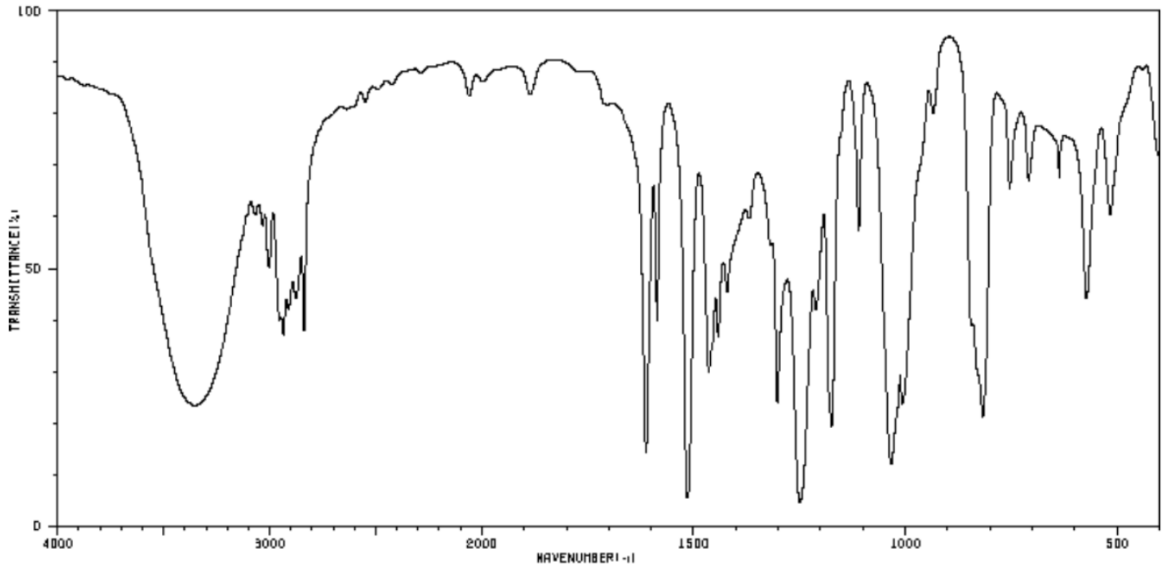


14. For the problem shown below, answer the questions and draw the structure that corresponds to the following spectra.

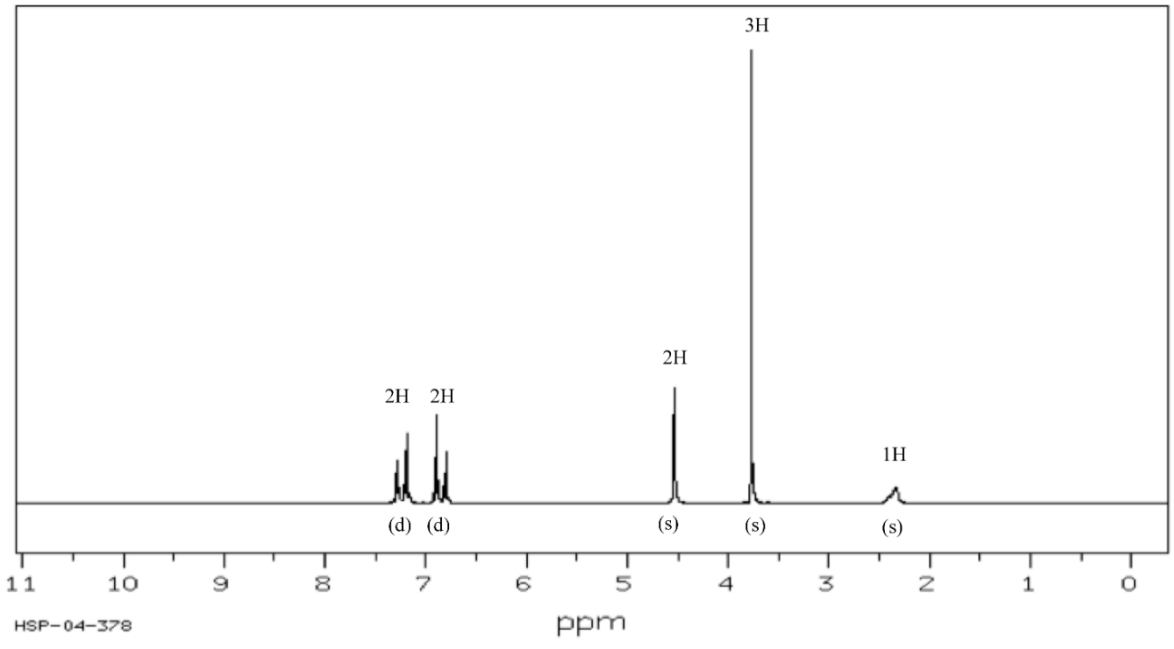
Empirical Formula: C_4H_5O

Mass Spec: M^+ m/e= 138

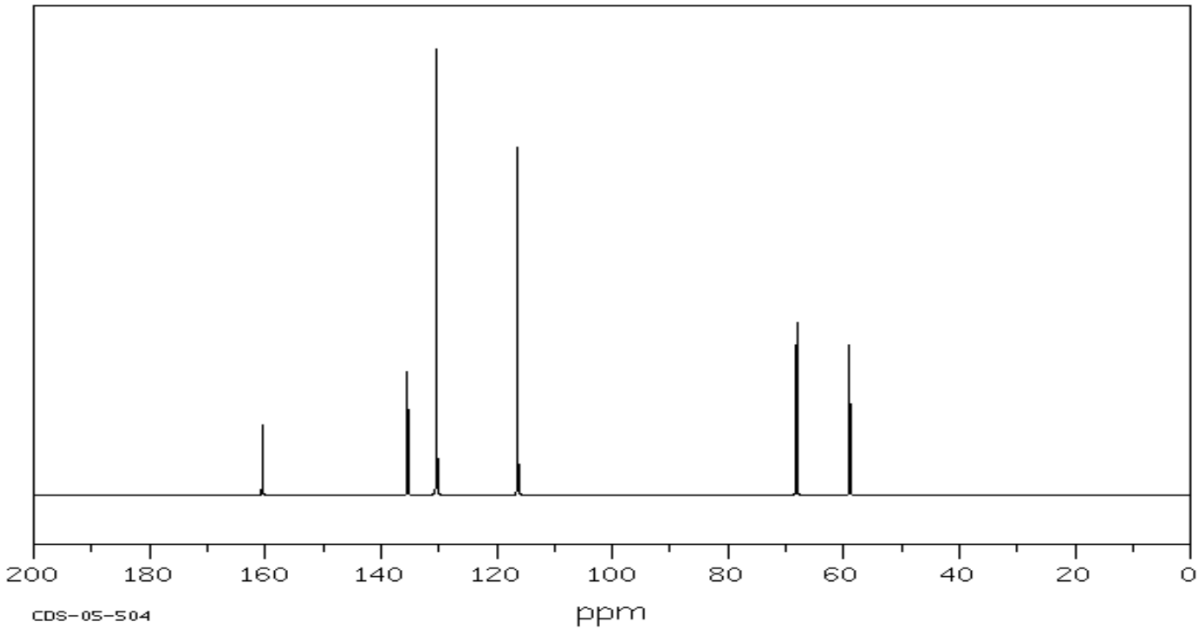
IR



^{1}H NMR



^{13}C NMR



Determination of the Molecular Formula (3pts)

a) What the molecular weight of the unknown compound? _____

b) What is the correct molecular formula of the unknown compounds? _____

c) How many degrees of unsaturation does this compound have? _____

Analysis of the IR spectrum (3 pts)
d) Which of the following bonds are present?

(circle all that are present) O-H C-O C=O

e) Based on the analysis of the IR, what type(s) of functional group(s) is/are present?

_____

Analysis of the 1H NMR spectrum (5 pts)

f) How many different protons are there in the molecule? _____

g) Which of the following are present? (circle all that apply)

Et iPr tBu H on a heteroatom vinylic H (i.e. an alkene) aromatic H

h) How many aromatic hydrogens are there? _____

i) How many substituents are there on the aromatic ring? _____

Analysis of the ^{13}C NMR (4pts)

j) How many different carbons are there in the molecule? _____

k) How many types of aromatic carbons are there in the molecule? _____

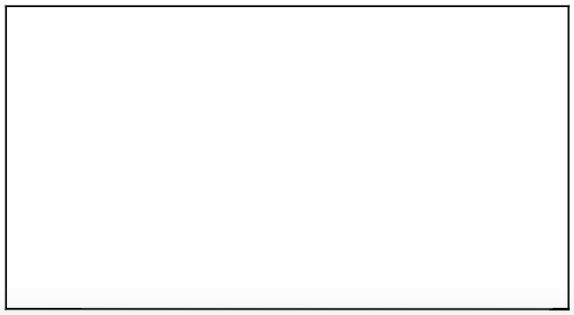
l) Is there a peak arising from a carbonyl in the ^{13}C NMR spectrum? (circle one) Yes No

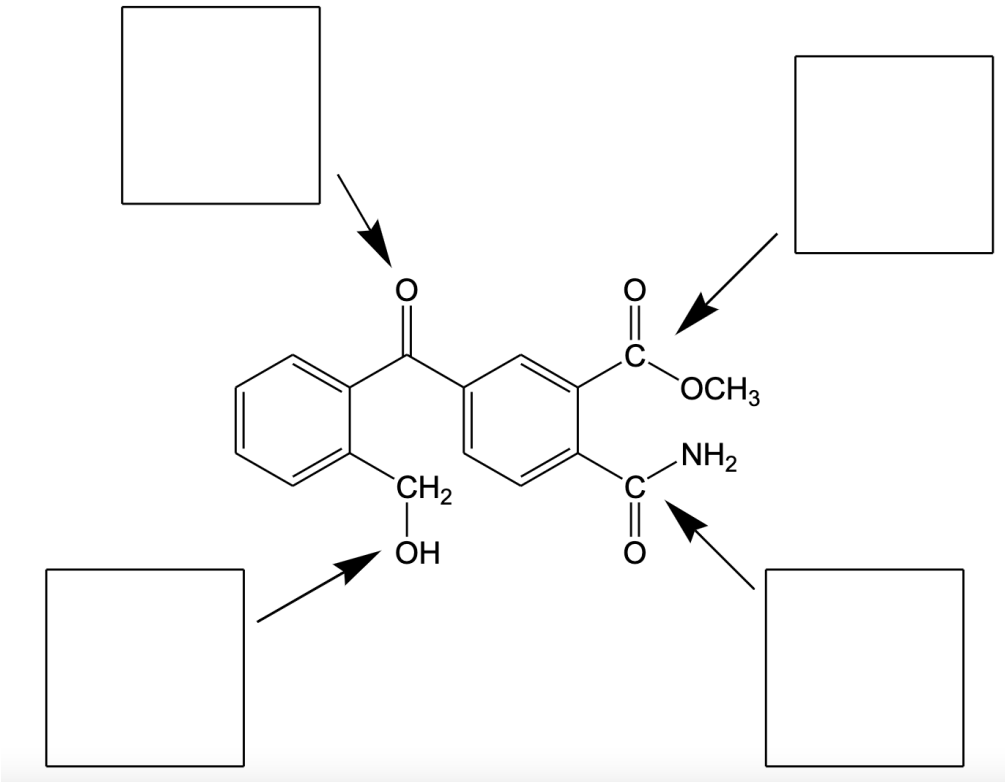
m) How many types of sp^3 carbons are there? _____

Putting it all together (5 pts)

n) Suggest a single structure for the molecule that is consistent with all of the data presented.

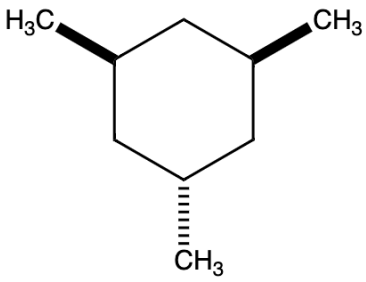
Note: Most of the credit for this problem comes from answering the questions above in the spaces provided.

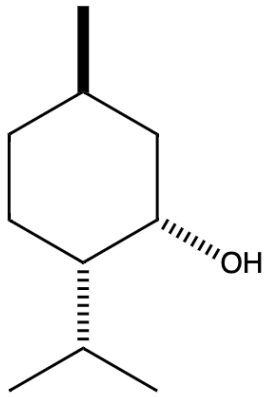




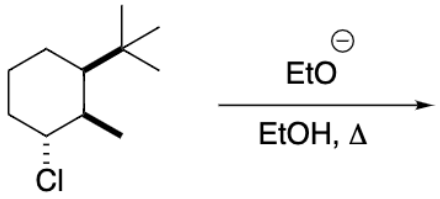
Note this is strictly for helping you on other problems (i.e. IR)! It's important you're familiar with some functional groups. :) You will not be tested about nomenclature only.

16. Draw the most stable chair conformation of the following compounds. (pts)

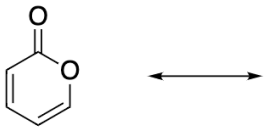




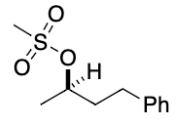
17.



18. Provide **three possible resonance contributors** for the following compound (12 pts total).



19.



KCN