

Total Score: \_\_\_\_\_

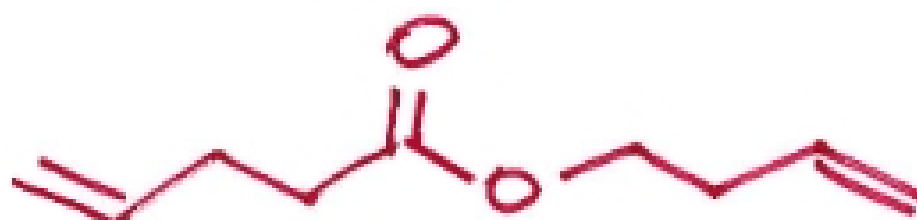
1.a) (2 pts) What is a possible molecular formula of an ester with  $M^+ = 154$ ? Show some calculations for credit.



b) (2 pts) What is the degree of unsaturation of this compound?

3

c) (2 pts) Propose a structure compatible with the information above.



*other possible*

2. Low resolution mass spectrometry analysis of a cyclic **Nitrogen, Oxygen, Carbon and Hydrogen** containing compound shows an  $M^+$  at  $m/z = 125$ .

a) (2 pts) Propose **one** possible molecular formula. Show some calculations for credit.



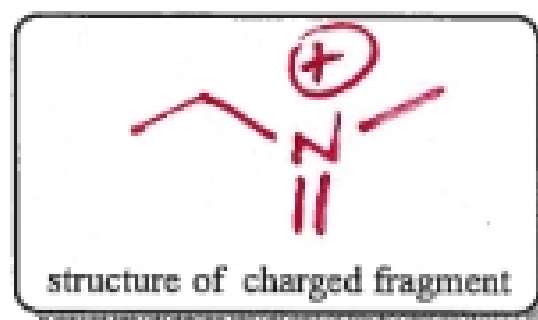
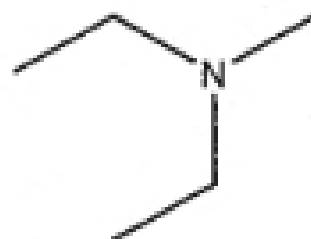
b) (2 pts) Calculate the degree of unsaturation.

3

c) (2 pts) Propose a structure compatible with the information above.



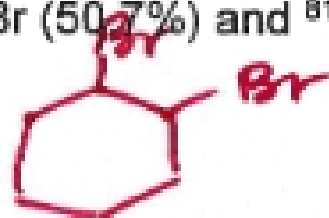
3. (4 pts) Consider the structure of the following secondary amine shown. Draw the structure of the charged fragment produced by alpha-cleavage (show lone pairs and charges as appropriate) and indicate its m/z value.



$$m/z = 72$$

4. (3 pts) Halogenated compounds are particularly easy to identify by their mass spectra because chlorine and bromine occur naturally as mixtures of two abundant isotopes. Chlorine occurs as  $^{35}\text{Cl}$  (75.8%) and  $^{37}\text{Cl}$  (24.2%); bromine occurs as  $^{79}\text{Br}$  (50.7%) and  $^{81}\text{Br}$  (49.3%).

For the compound 1,2-dibromocyclohexane



At what masses do the molecular ions occur? :

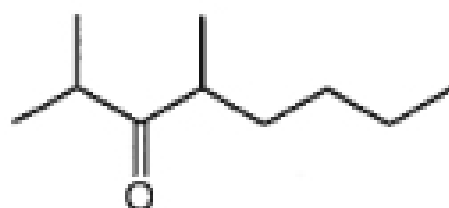
$$240, 242, 244$$

What are the relative percentages of each molecular ion? :

$$25.7\%, 50\%, 24.3\%$$

5. (4 pts) The molecular ion for the following ketone is at m/z: 156.

Enter in the boxes the **structure** and the **mass of the neutral fragment** resulting from a McLafferty rearrangement.

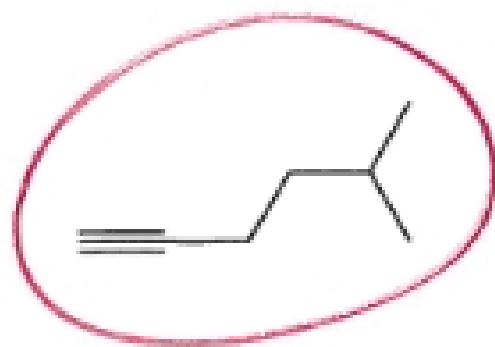


structure of neutral fragment

$$56$$

mass of the neutral fragment

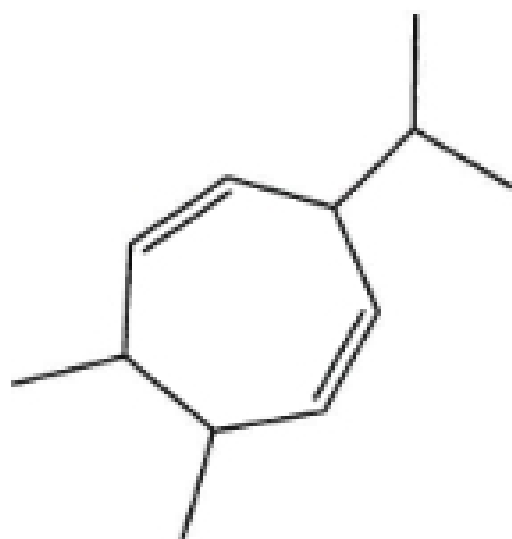
6. (3 pts) What IR absorption would you use to distinguish the following two compounds? Circle the compound that exhibits this absorption.



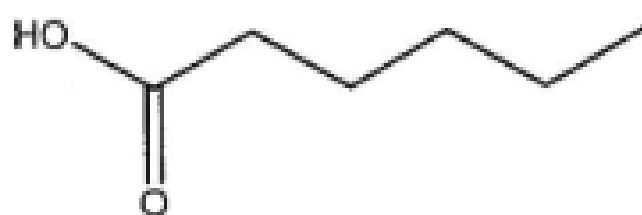
C-H  
alkyne

3300  $\text{cm}^{-1}$

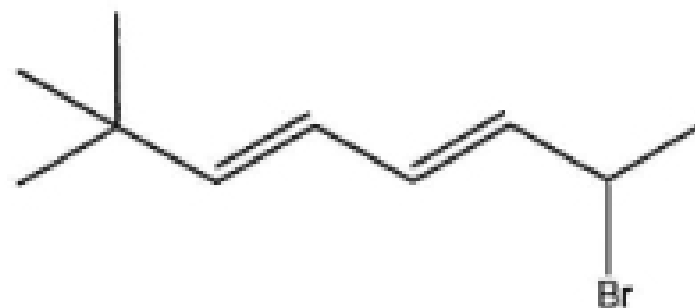
7. (6 pts) Determine the number of signals in the broad-decoupled  $^{13}\text{C}$ -NMR spectrum of each of the compounds shown below. Enter a number in each box.



7

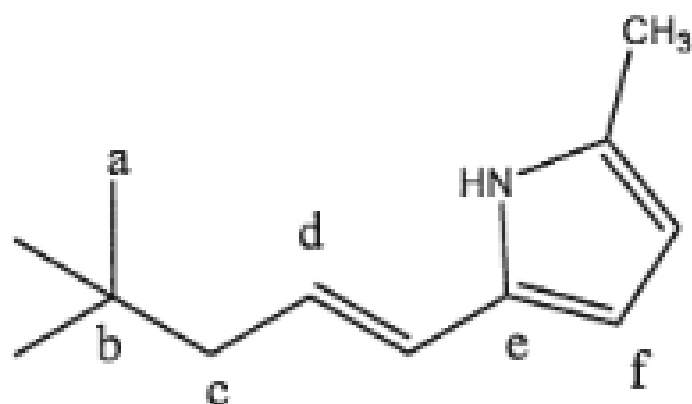


6



8

8. (6 pts) In the box below enter the pattern of signals ( 0 means no signal, + means positive signal, and - means negative signal) expected for the following compound:



	DEPT 90	DEPT 135
a	0	+
b	0	0
c	0	-
d	+	+
e	0	0
f	+	+