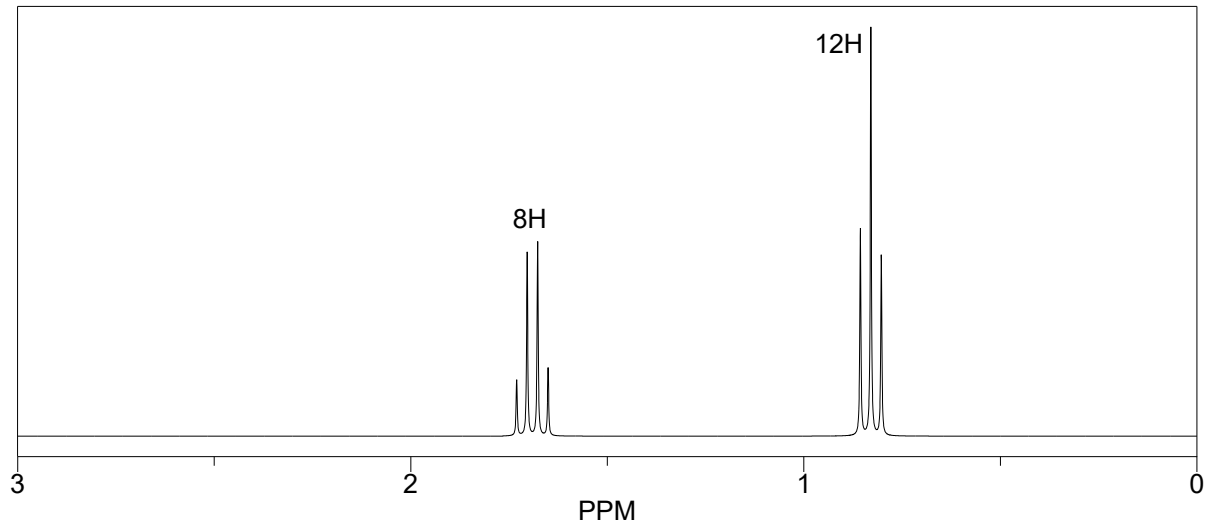
NAME_____ PID_____

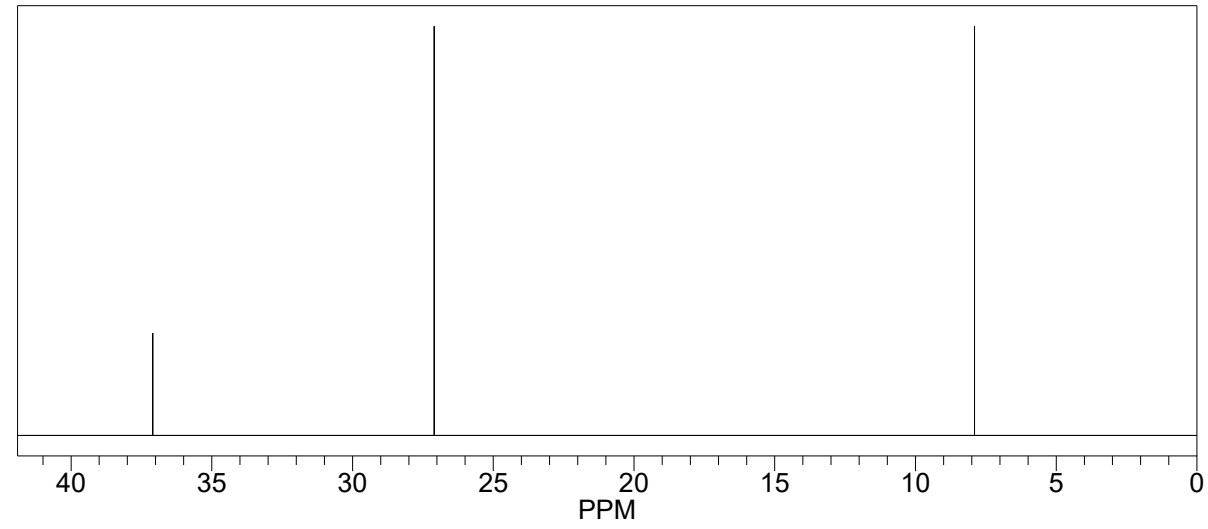
1) Calculate the degree of unsaturation for the formula (C_9H_{20}) ☐ **(1 pt)**

^{1}H-NMR NMR (Show structure fragment work in spectrum) (2 pts)



^{13}C-NMR (Show structure fragments work in spectrum) (2 pts).

Sometimes the DEPT function stops working or the undergraduate NMRs at your University don't have the DEPT option. This is the situation here.



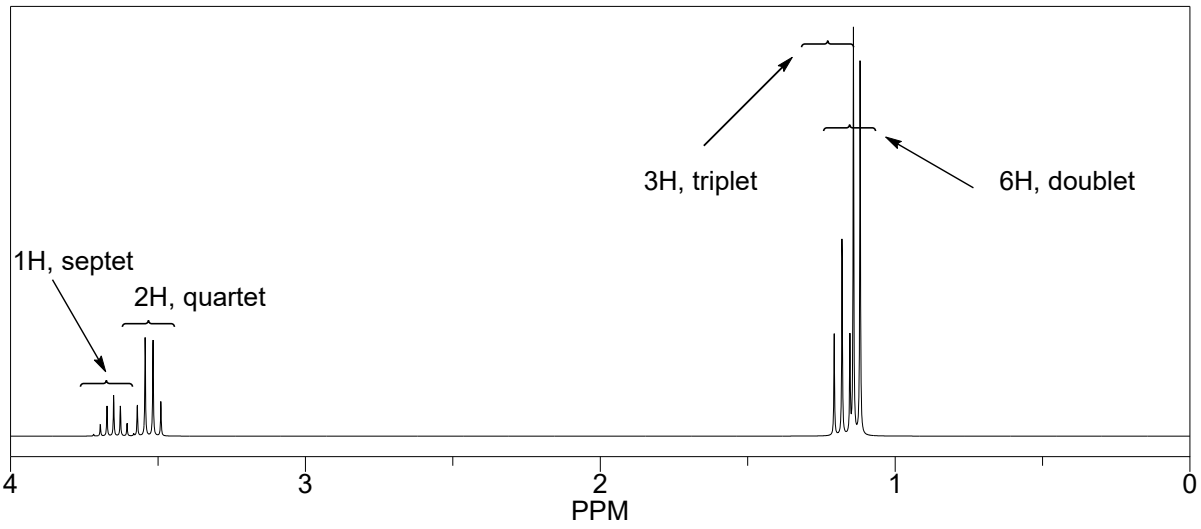
2) Structure here. (2 pts)

Structure MUST BE PLACED Here
(show work for credit)

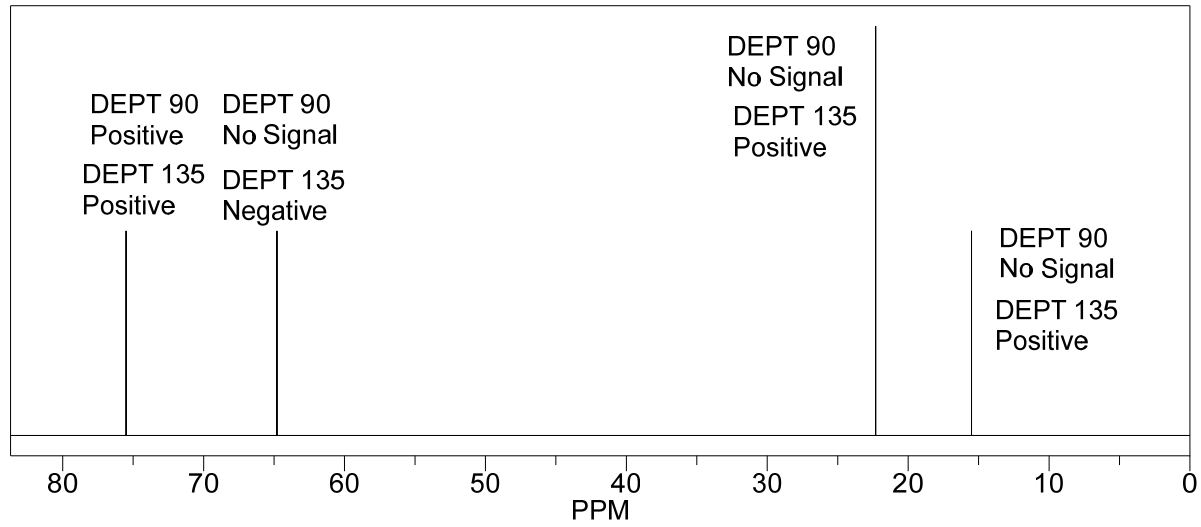
NAME_____ PID_____

3) Calculate the degree of unsaturation for the formula ($C_5H_{12}O$) ☐ **(1 pt)**

^{1}H-NMR (Show structure fragments work in spectrum) (2 pts)



^{13}C-NMR (Show structure fragments work in spectrum) (2 pts)



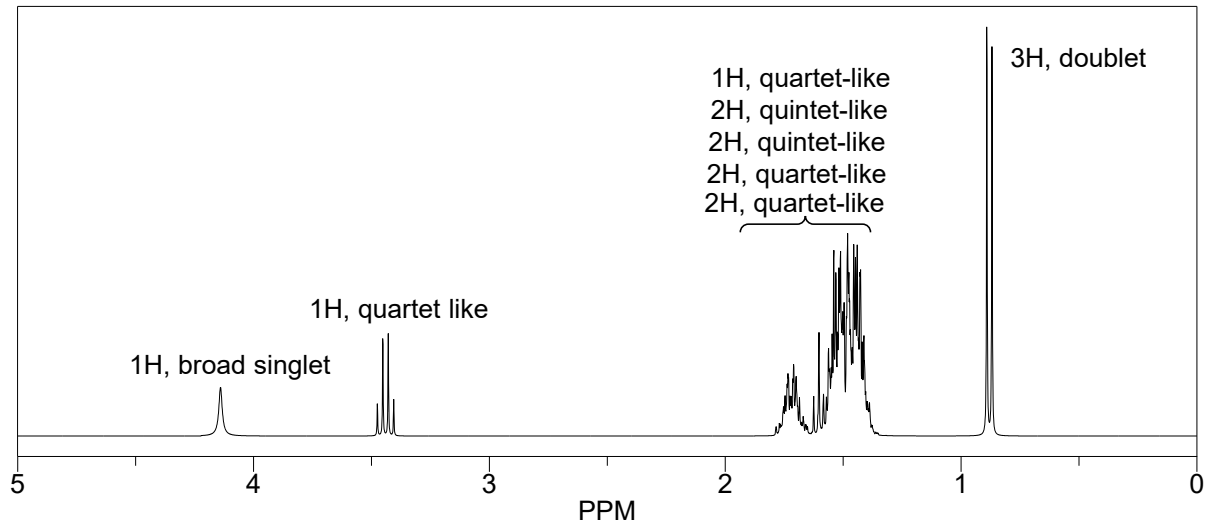
4) Structure here. (2 pts)

Structure MUST BE PLACED Here
(show work for credit)

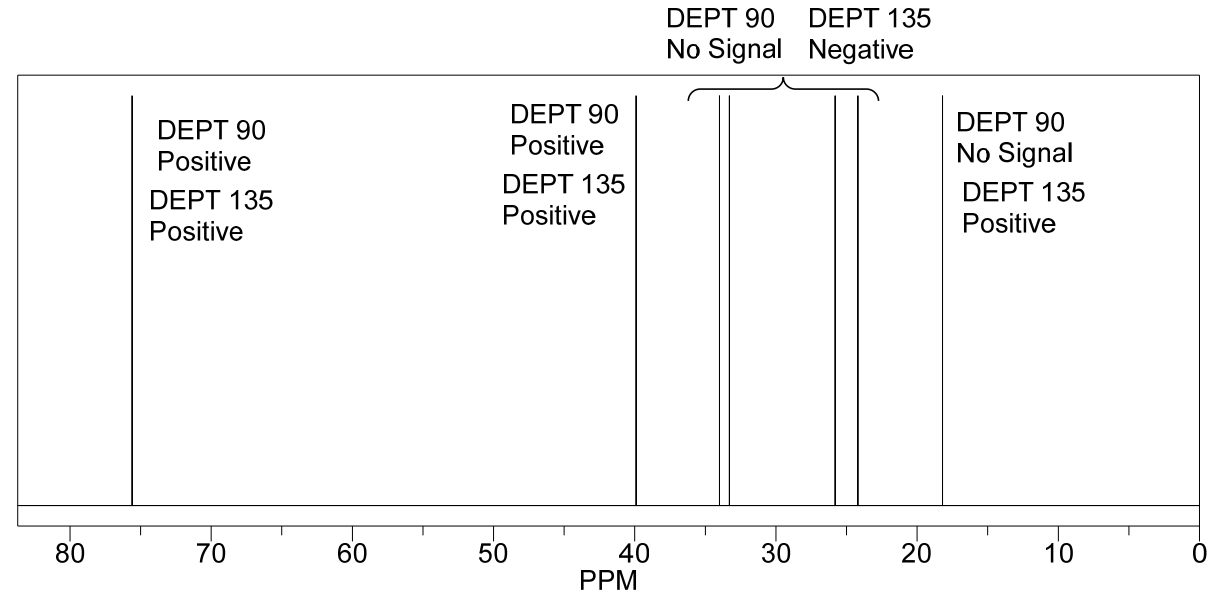
NAME_____ PID_____

5) Calculate the degree of unsaturation for the formula ($C_7H_{14}O$) ☐ (1 pt)

^{1}H-NMR (Show structure fragments work in spectrum) (2 pts)



^{13}C-NMR (Show structure fragments work in spectrum) (2 pts)



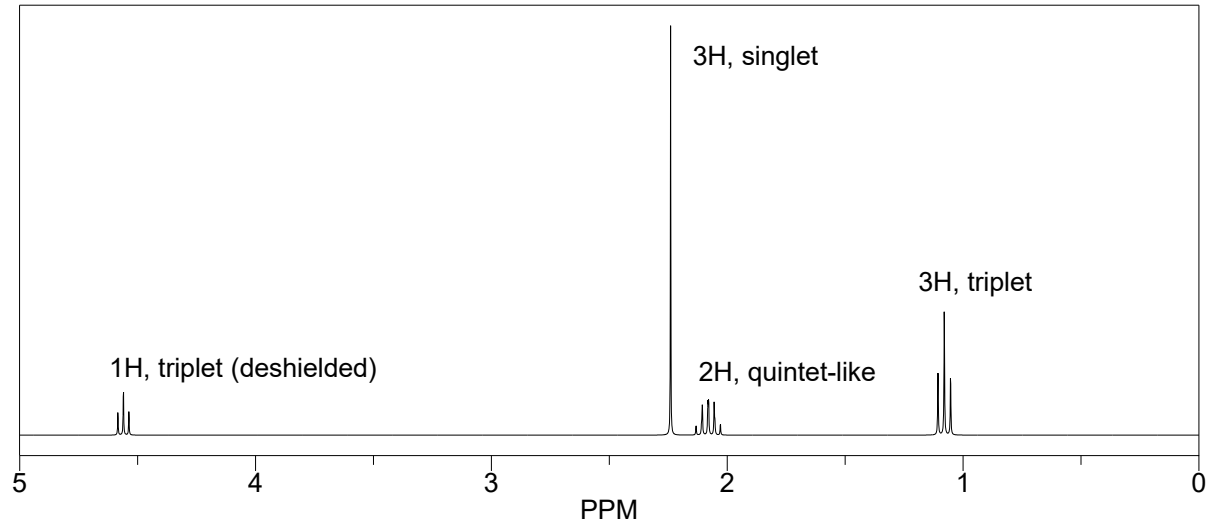
6) Structure here (2 pts)

Structure MUST BE PLACED Here (show work for credit)

NAME_____ PID_____

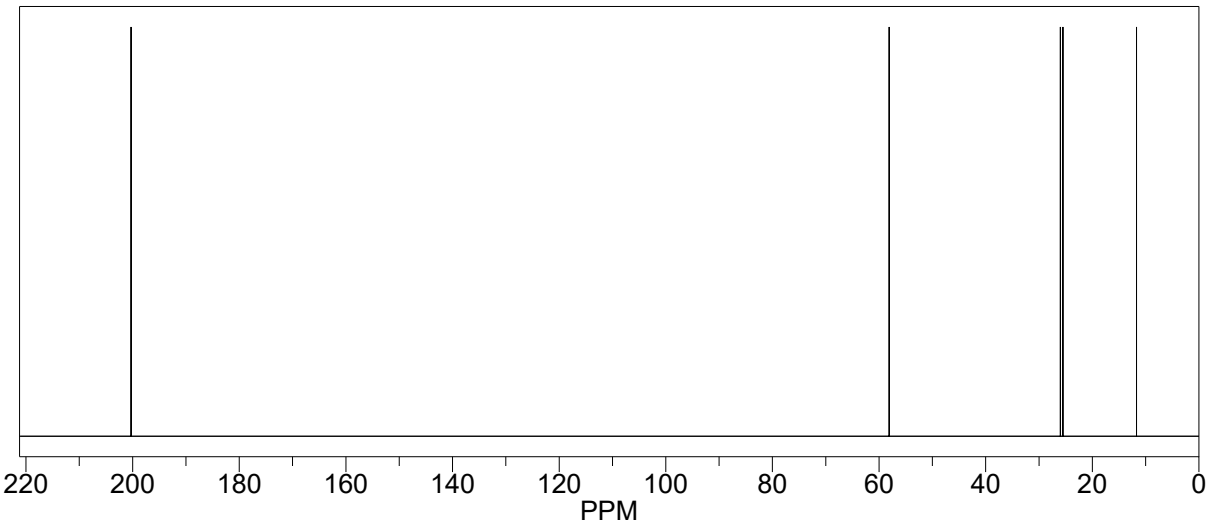
7) Formula (C_5H_9BrO)

^{1}H-NMR (Show structure fragments work in spectrum) (2 pts)



^{13}C-NMR (Show structure fragments work in spectrum) (2 pts).

Sometimes the DEPT function stops working or the undergraduate NMRs at your University don't have the DEPT option. This is the situation here.

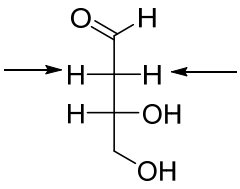


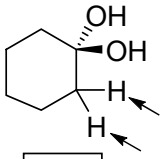
8) Structure here (2 pts)

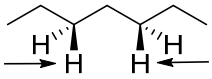
Structure MUST BE PLACED Here
(show work for credit)

NAME_____ PID_____

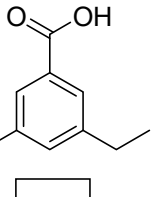
9) Identify the indicated sets of protons as (U)nrelated, (H)omotopic, (E)nantiotopic or (D)iastereotopic (3 pts)





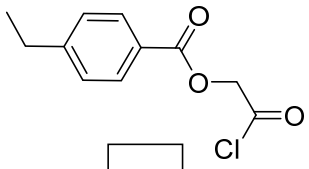


10) How many kinds of *nonequivalent* carbons (C) and protons (H) are present in the following? That is, how many unique ^{1}H and ^{13}C signals will you observed in an NMR spectrum for each. (4 pts)



# of C

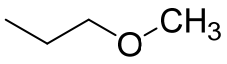
# of H

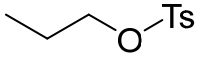


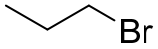
# of C

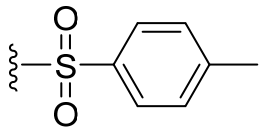
# of H

11) Arrange each set from 1 (slowest) to 3 (fastest) reactant in an S_N2 reaction. (3 pts)

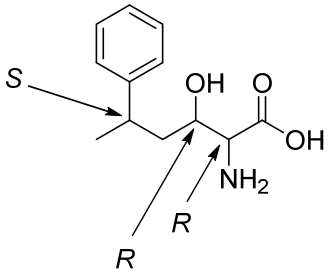






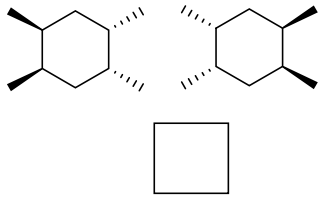
Ts = 

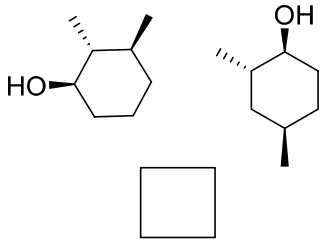
12) Draw the compound below with wedged (◄) and/or dashed (·····) lines to show the 3-D aspect of the chirality centers below. (3 pts)



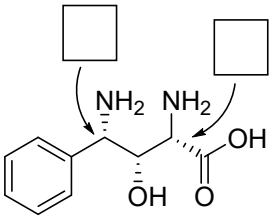
NAME_____ PID_____

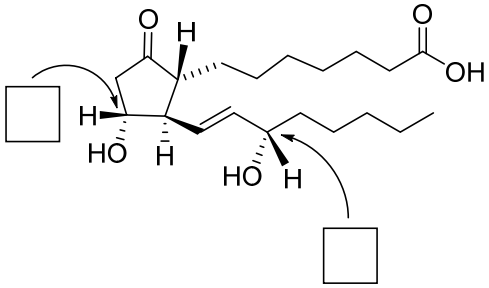
13) Identify whether the following molecules are (E)nantiomers, (I)dentical, (D)iastereoisomers, (C)onstitutional Isomers, or (N)ot isomers. Place appropriate letter in the box. (2 pts)

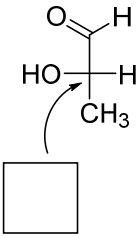




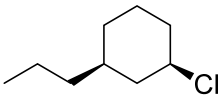
14) Assign R or S configuration to the chiral center(s). (5 pts)



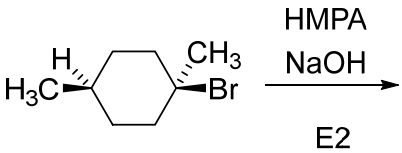




15) Name. (3 pts) Use stereochemical descriptors with their numerical location(s) in the name.



16) (7 pts total) Under the condition shown, draw ALL the product(s) for the MOST LIKELY reaction mechanism below (Include stereochemistry, if necessary). (6 pts) Circle the reaction mechanism below the arrow. (1 pts) Take your time.



E2

S_N2

E1

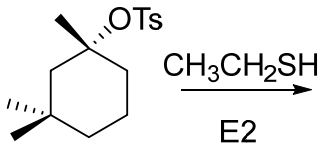
S_N1

If fewer than 3 products place an X in the box(es) not used

Draw HMPA (2 pt Bonus)

NAME_____ PID_____

17) (7 pts total) Under the condition shown, draw ALL the product(s) for the MOST LIKELY reaction mechanism below (Include stereochemistry, if necessary). (6 pts) Circle the reaction mechanism below the arrow. (1 pts). Note the reactant above arrow; remember what it can ONLY function as. Take your time.



E2

S_N2

E1

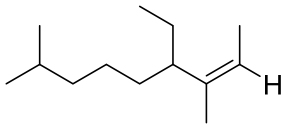
S_N1

If fewer than 3 products place an X in the box(es) not used

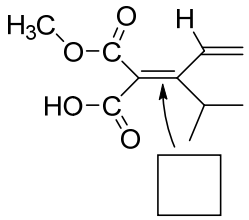
18) Draw. (3 pts)

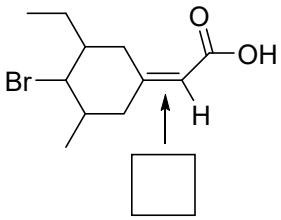
3-isopropyl-2,4-dimethyl-2-pentene

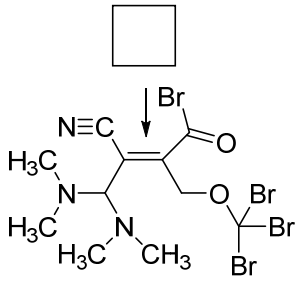
19) Name. Include E/Z stereochemistry in name, if necessary. (3 pts)



20) (9 pts total) Assign *E* or *Z* configuration (1 pt). CIRCLE both highest priority groups for in each. (1 pt each circle)

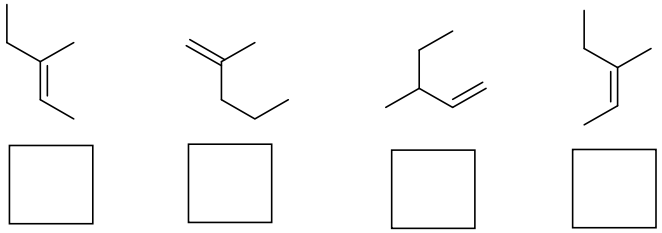




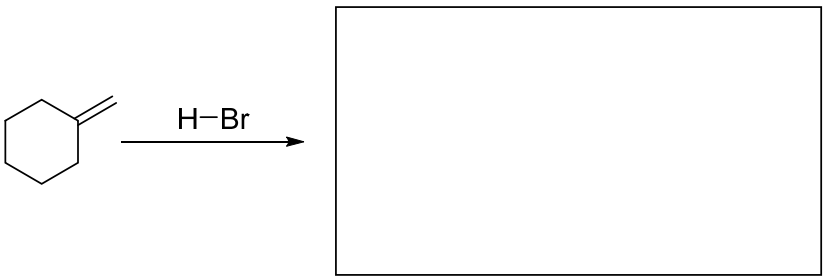


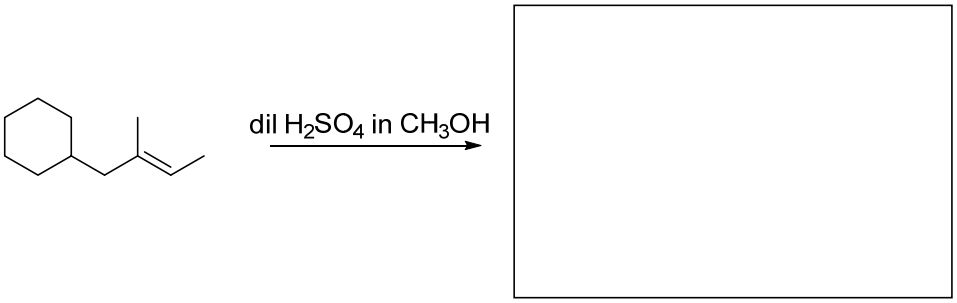
NAME_____ PID_____

21) Arrange the following in order of increasing stability (1 is LEAST stable; 4 is MOST stable).



22) Draw the MAJOR (most abundant) product made in the reaction. IF NEW STEREOCENTER(S) IS/ARE MADE, PLACE A DOT ( ) ON THE CHIRALITY CENTER(s). (6 pts)





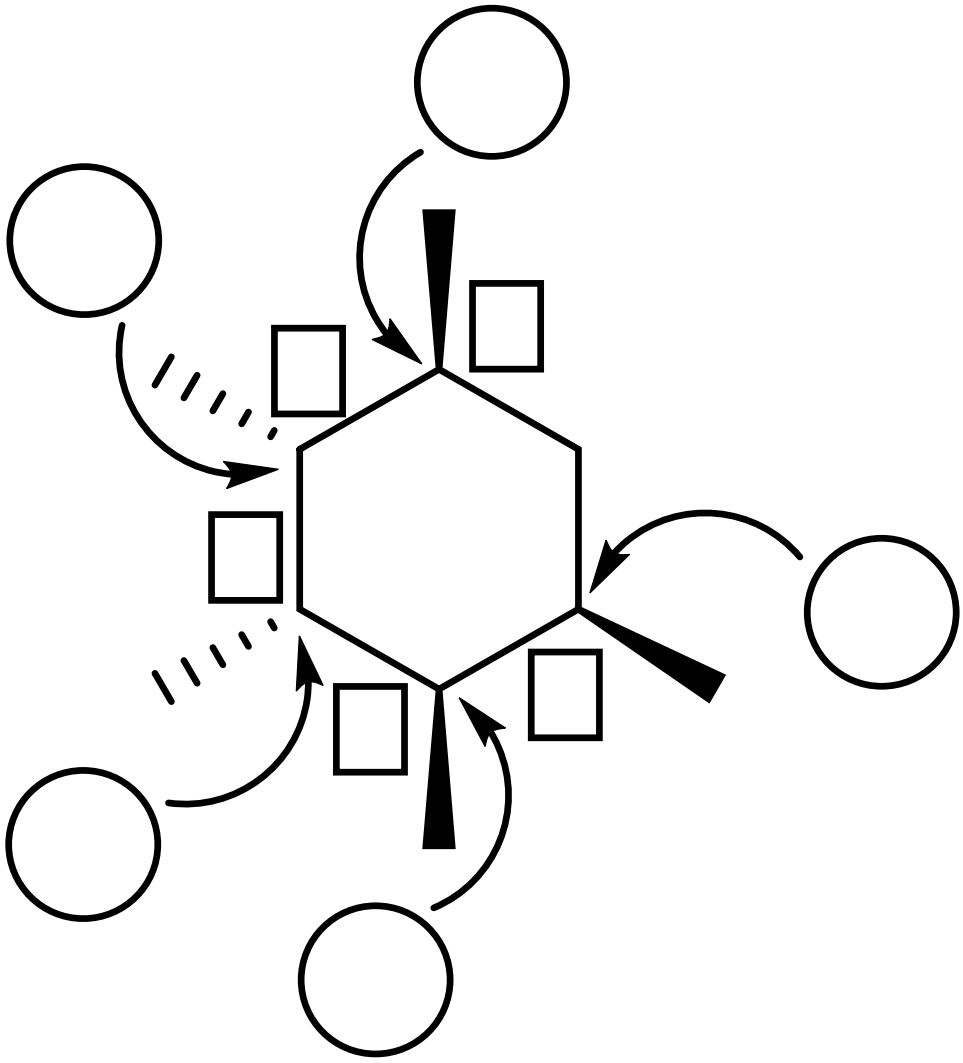
23) Identify the products of the following Elimination reactions. (6 pts)
1) If only a MAJOR product is made, draw an X in the MINOR box.
2) If no reaction draw X in both boxes
3) Disregard trans/cis stereochemistry as MAJOR/MINOR for this problem.

24) (7 pts total) Identify the STEREOISOMERIC products of the following Elimination reactions (6 pts). Circle the reaction mechanism below the arrow (1 pt each). If TWO PRODUCTS ARE NOT MADE, THE DRAW AN X IN THE BOX DESIGNATED 'MINOR'

NAME_____ PID_____

Bonus: Must be completely correct for credit 5 points

Place numbers 1, 2, 3, 4, 5 in the BOXES to designate C1, C2, C3, C4, C5, and write *R* or *S* stereochemical descriptors in the CIRCLES of pentamethylcyclohexane below



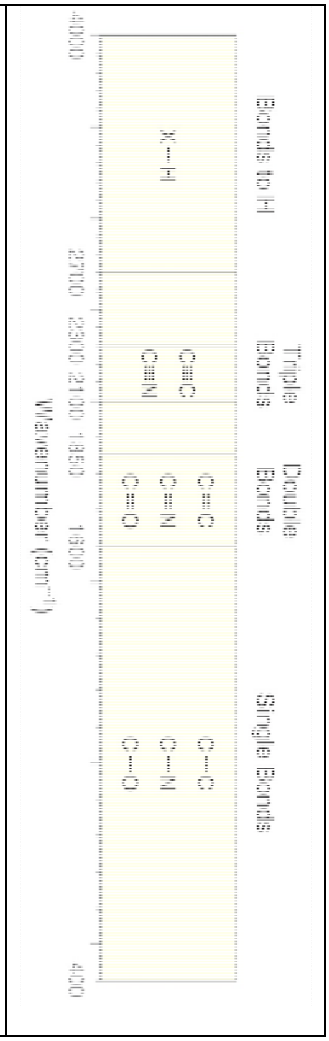
NAME_____ PID_____

TABLE 16.2 CHEMICAL SHIFTS FOR PROTONS IN DIFFERENT ELECTRONIC ENVIRONMENTS

TYPE OF PROTON	CHEMICAL SHIFT (δ)	TYPE OF PROTON	CHEMICAL SHIFT (δ)
Methyl R—CH_3	~0.9	Alkyl halide R—C(H)(R)—X	2–4
Methylene CH_2	~1.2	Alcohol R—O—H	2–5
Methine CH	~1.7	Vinylic C=C—H	4.5–6.5
Allylic C=C—C—H	~2	Aryl —H	6.5–8
Alkynyl R—C≡C—H	~2.5	Aldehyde R—C(=O)—H	~10
Aromatic methyl —CH_3	~2.5	Carboxylic acid R—C(=O)—O—H	~12

TYPE OF PROTON	CHEMICAL SHIFT (δ)
Allylic C=C—C—H	~2
Alkynyl R—C≡C—H	~2.5
Aromatic methyl —CH_3	~2.5

TYPE OF PROTON	CHEMICAL SHIFT (δ)
Methyl R—CH_3	~0.9
Methylene CH_2	~1.2
Methine CH	~1.7



Carbon atoms of carbonyl groups. These carbon atoms are highly deshielded.	sp^2-hybridized carbon atoms.	*sp*-hybridized carbon atoms as well as sp^3-hybridized carbon atoms that are deshielded by electronegative atoms.	sp^3-hybridized carbon atoms (methyl, methylene, and methine groups).