

1. (2pts) What is meant by "shielding" in NMR?

Nuclei are "shielded" from the external magnetic field by e^- density which generates an opposing field that partly cancels the external field.

(+1) concept of e^- shielding

(+1) concept of magnetic field counteracting external field

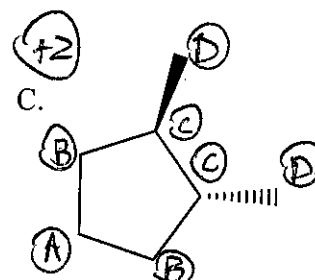
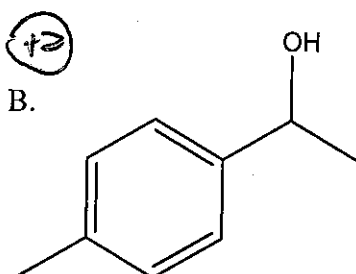
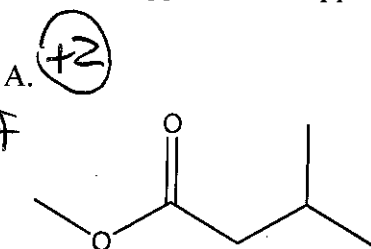
2. (2pts) On a 60MHz NMR, a signal resonating at 90 Hz would be observed at 1.5 ppm. The same signal would resonate at 300 Hz on a 200MHz instrument.

(+1)

(+1)

3. (6pts) Fill in the table with each of the given compounds by writing the number of signals that would appear in each ppm range in a C-13 NMR. Write "0" if there are none.

For each
+1 for right # of signals
+1 for all chemical shifts correct



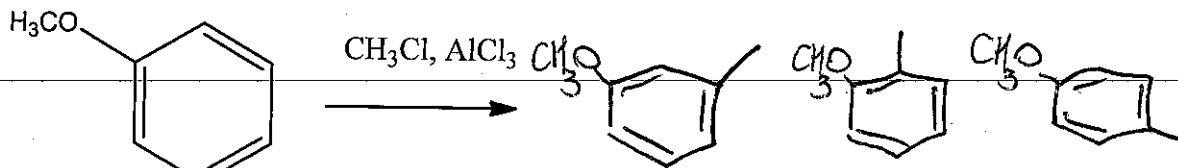
ppm range	# of signals	ppm range	# of signals	ppm range	# of signals
5-45	3	5-45	2	5-45	4
40-70	1	40-70	1	40-70	0
70-100	0	70-100	0	70-100	0
100-160	0	100-160	4	100-160	0
160-220	1	160-220	0	160-220	0

total = 5

total = 7

total = 4

4. (4pts) Friedel-Crafts methylation of anisole leads to formation of two products, a major product A and a minor product B, plus a trace amount of a third compound, product C, which arose from methylation at the ortho, meta, and para positions. Would you be able to use C-13 NMR data to distinguish between the major, minor, and trace products? Explain.



6 aromatic 6 aromatic 4 aromatic

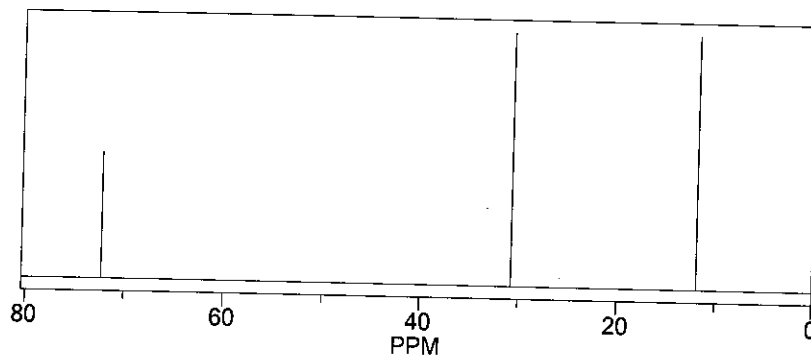
(+2) answer based on # of equivalent aromatic carbon

(+2) The para-substituted can be distinguished, but not ortho- and meta- based only on C-13

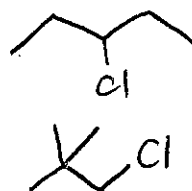
5. (6pts) Propose two structures for $C_5H_{11}Cl$ compounds consistent with each of these C-13 NMR spectra:

+1 for each

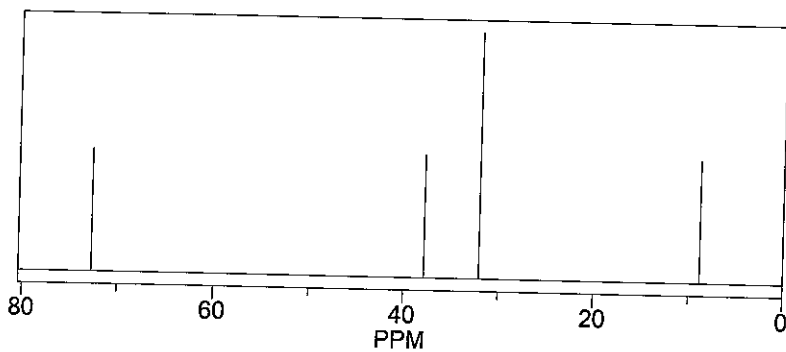
A.



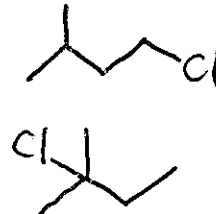
structures:



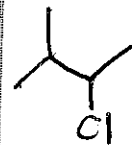
B.



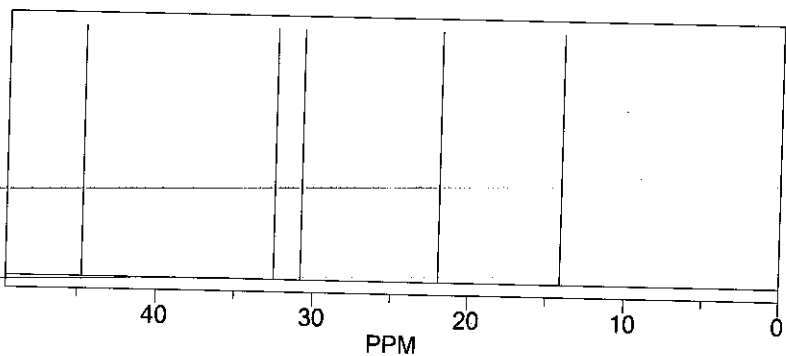
Structures:



not



C.



Structures:

