

Homework 6
Organic Chemistry MCAT Review
Summer 2012
Brent Iverson

1. Fill in each blank with the word that best completes the following sentences about NMR.

The two most important isotopes for organic chemistry structure determination by NMR are _____ and _____. Of these two, _____ is a common isotope and the predominant isotope found in molecules, while _____ is relatively rare.

Nuclei with spin quantum number $1/2$ are quantized in one of two orientations: _____ (lower energy) or _____ (higher energy) in the presence of an external magnetic field, that is, with and against the external field, respectively.

The difference in energy between nuclear spin states is _____ to the strength of the magnetic field experienced by the nucleus.

Electron density is induced to move in a strong external magnetic field, and this movement induces a _____ field that is _____ to the external magnetic field. This has the effect of _____ the underlying nuclei from the external magnetic field.

All other factors being the same, the signal for an ^1H atom with greater electron density around it will come at _____ ppm in an NMR spectrum compared to a similar ^1H atom with less electron density.

The _____ of adjacent nuclei influence each other. If ^1H atoms are no more than _____ bonds apart, the spin states couple.

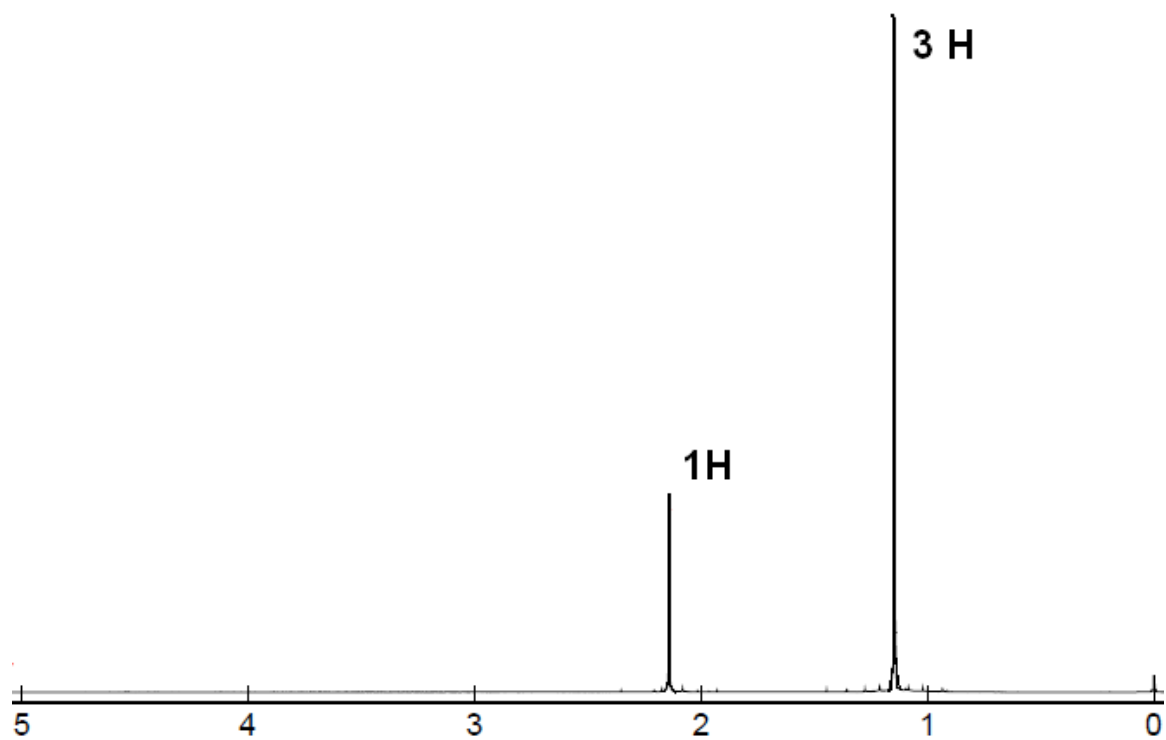
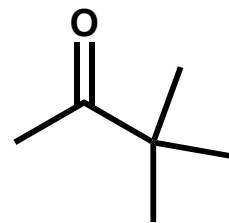
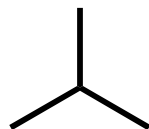
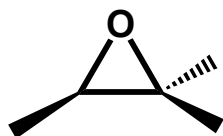
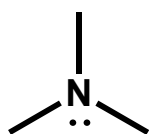
1. (cont.)

In the FT NMR method, the FT stands for _____ .

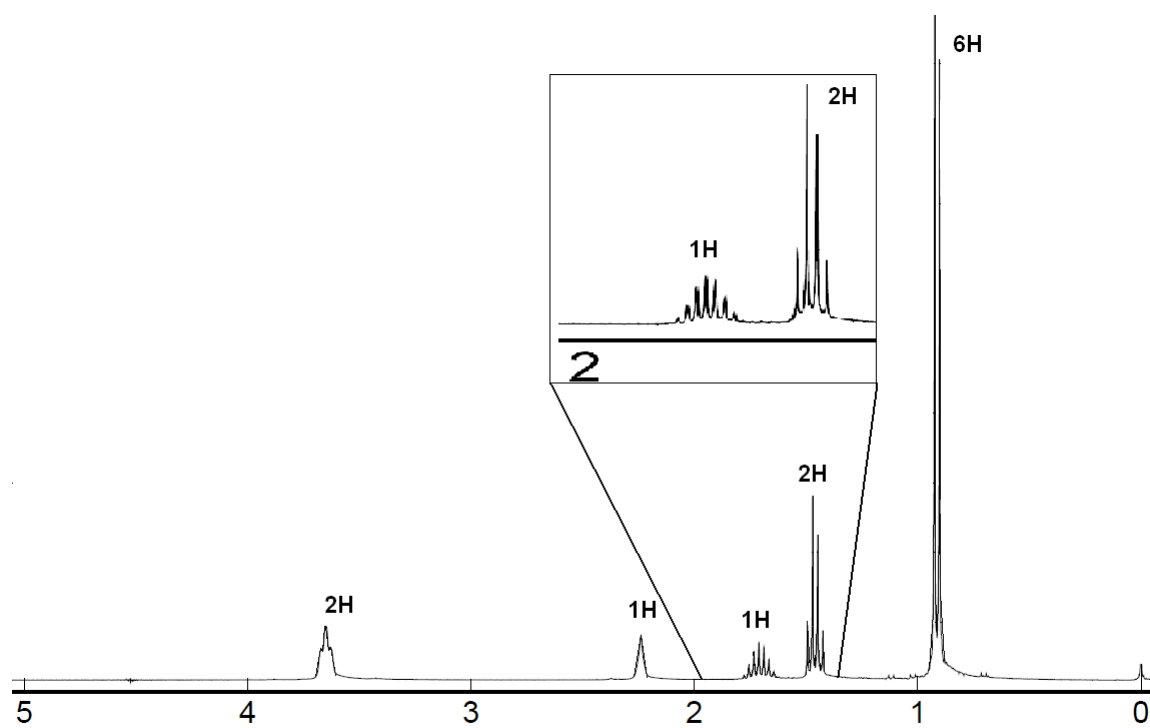
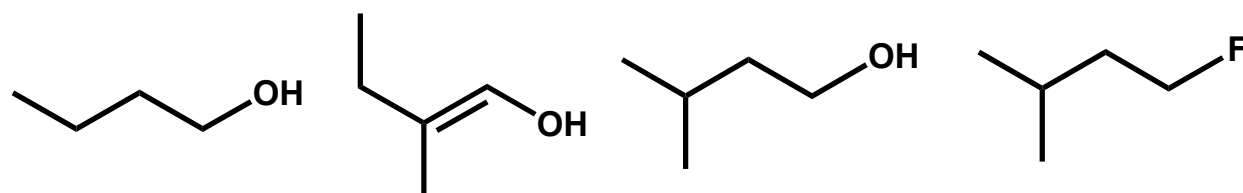
The basic idea is that a short pulse using a range of radio frequencies is used to flip the spins of all of the hydrogen _____ at once. Then, the nuclear spins _____ back to the $+1/2$ spin state and when they do, they _____ electromagnetic radiation at the precise frequency at which they absorb.

2. Suppose a relative of yours is having an MRI. In no more than four sentences, explain to them what is happening when they have the MRI scan. There are a minimum of 7 key points here.

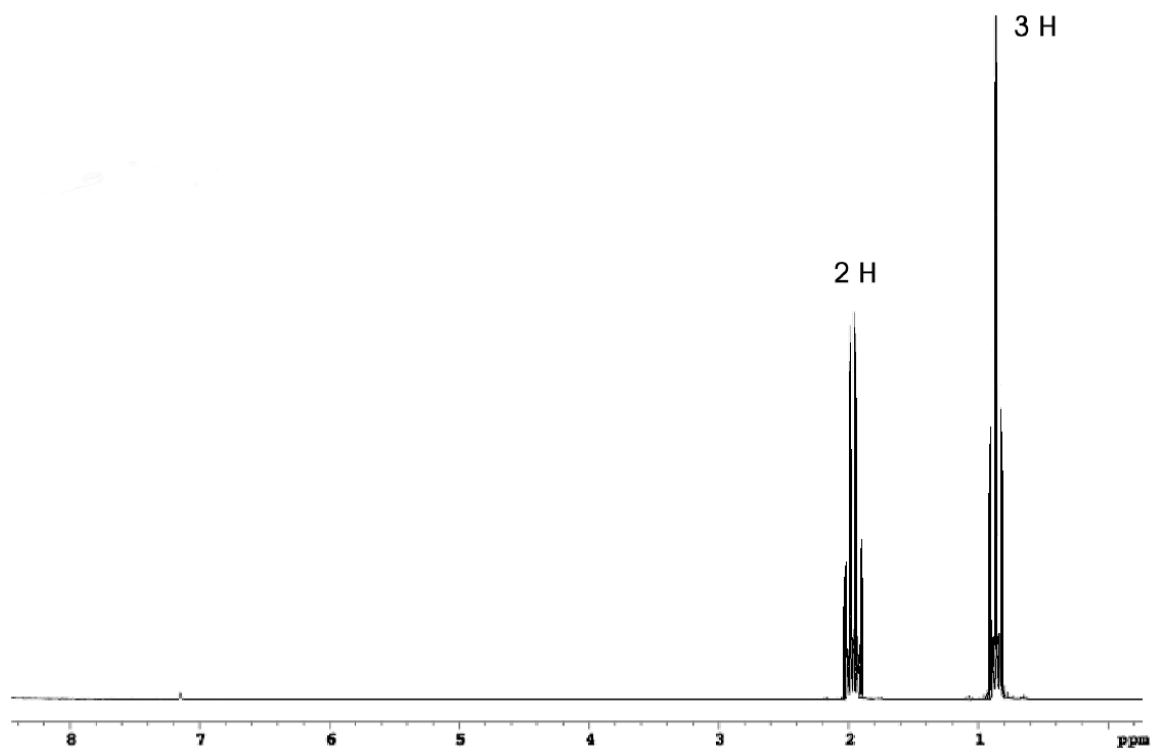
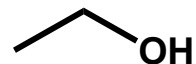
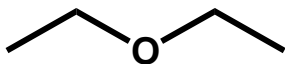
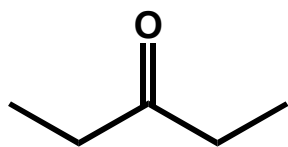
3. Circle the molecule that corresponds to the NMR spectrum shown below.



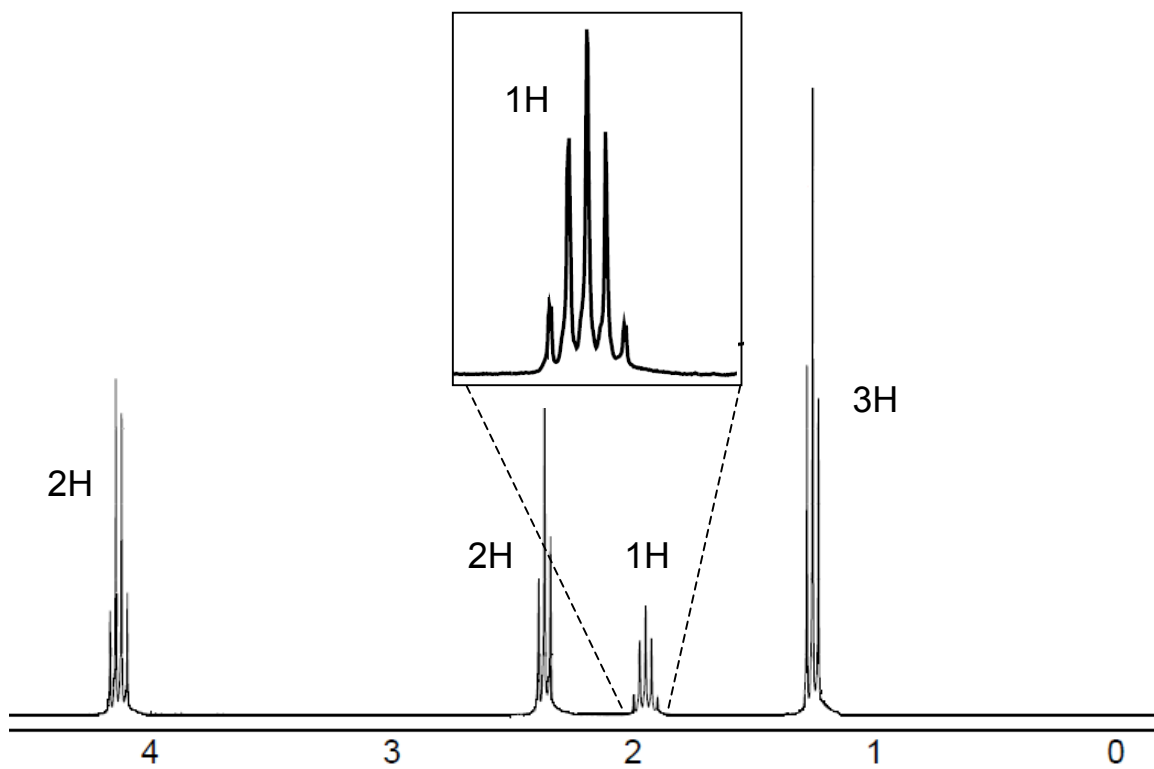
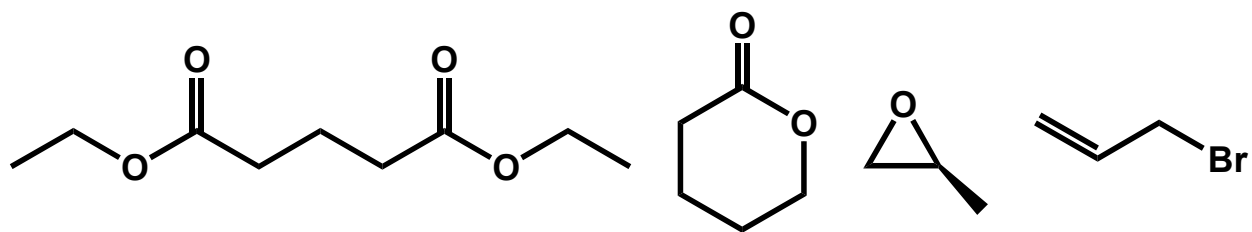
3. Circle the molecule that corresponds to the NMR spectrum shown below.



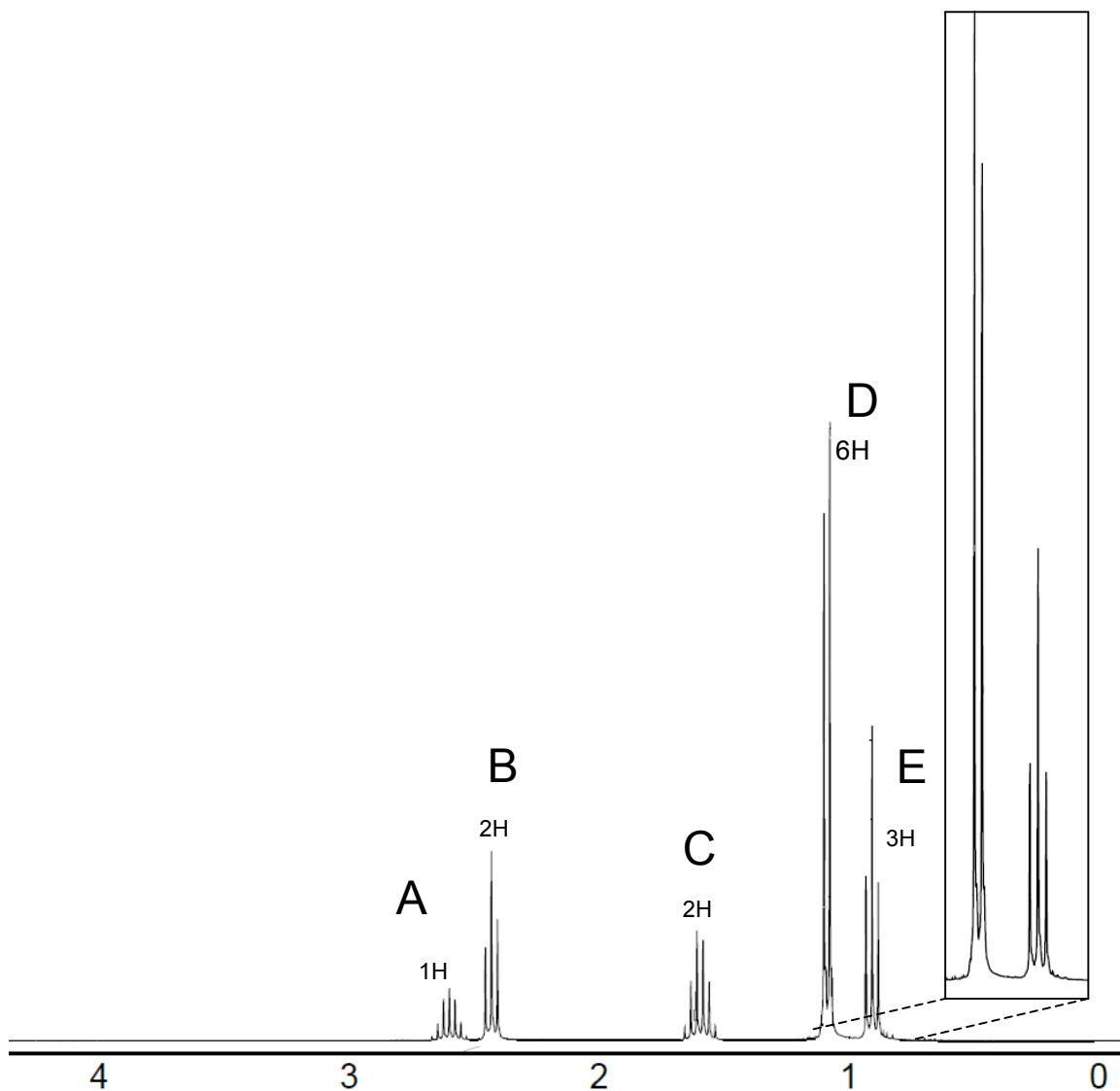
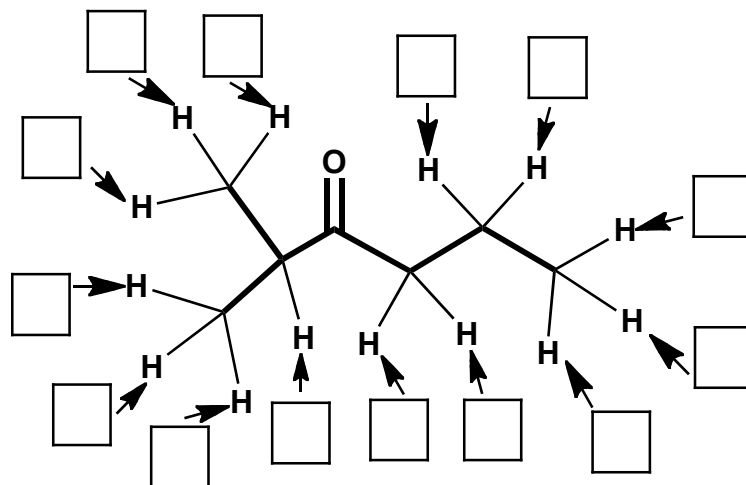
3. Circle the molecule that corresponds to the NMR spectrum shown below.



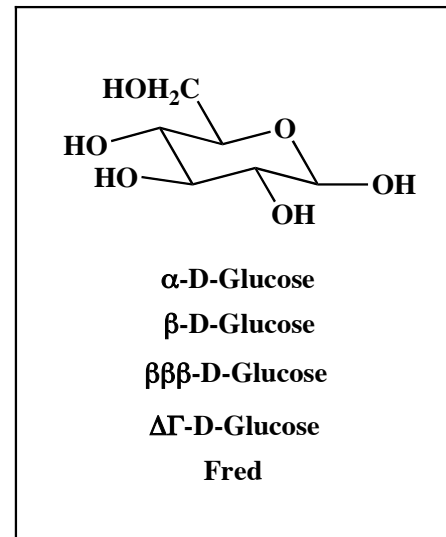
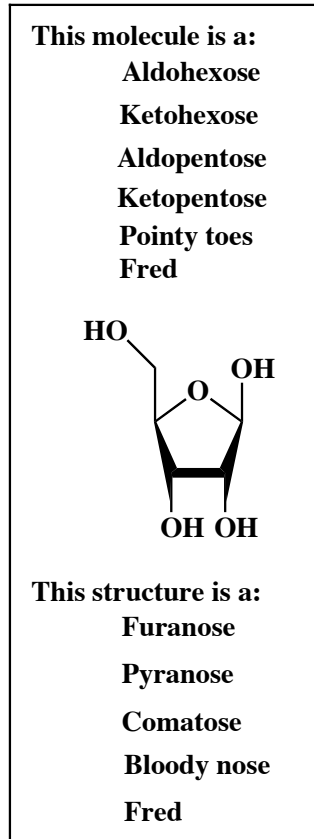
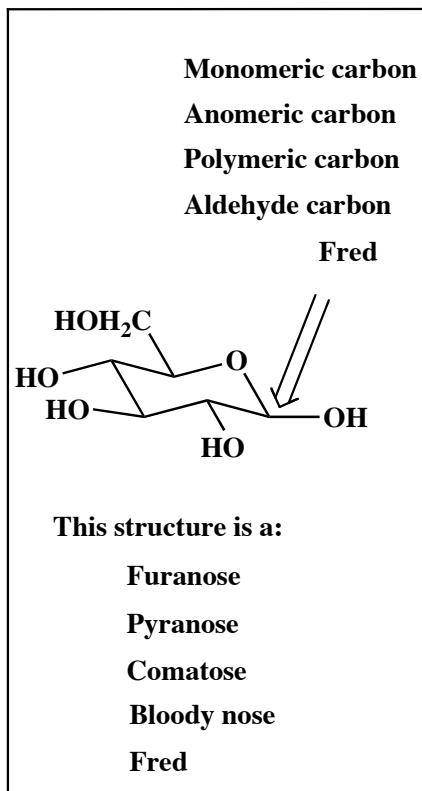
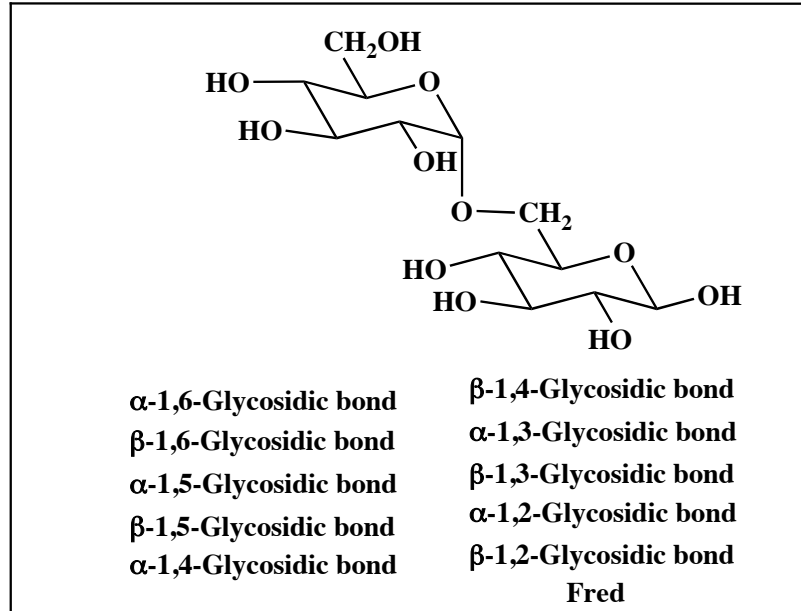
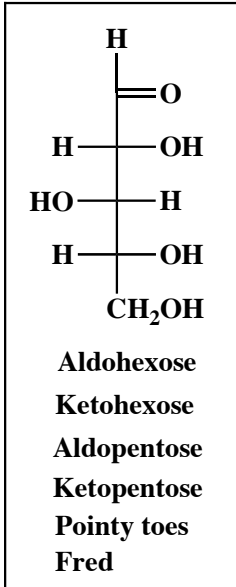
3. Circle the molecule that corresponds to the NMR spectrum shown below.



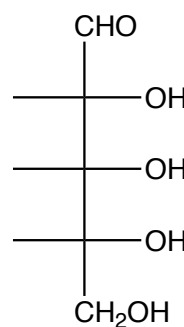
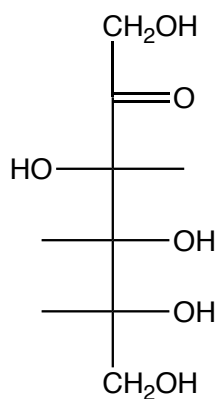
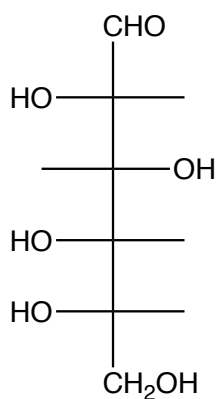
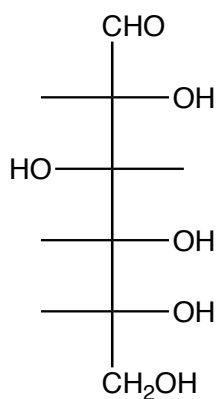
4. In the boxes provided, place that letter (A, B, C, etc.) that corresponds to the signals in the spectrum provided below.



5. For the following structures, draw a circle around the terms that provide the most accurate description.



6. For the following carbohydrates, draw a circle around all of the D-carbohydrate(s), and draw a rectangle around all of the L-carbohydrate(s). On the two first two lines below the four structures, indicate whether each is an aldose or ketose, and whether each is a pentose or hexose, respectively. On the third line below each structure, construct a compound name from all of these elements. For example, answers might be L-ketopentose or L-aldohexose. Finally, on the fourth line under each structure write the specific name (i.e. D-glucose) for each structure. You should use table 25.1 or other structures named in the book (5th Ed. Brown, Foote, Iverson and Anslyn) to identify these exact sugar names. (You will NOT need to know them for the MCAT).

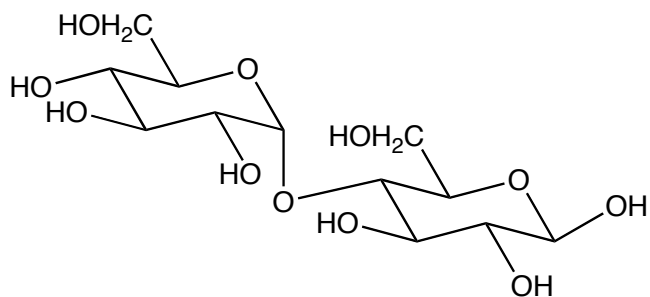


(aldose or ketose?)

(pentose or hexose?)

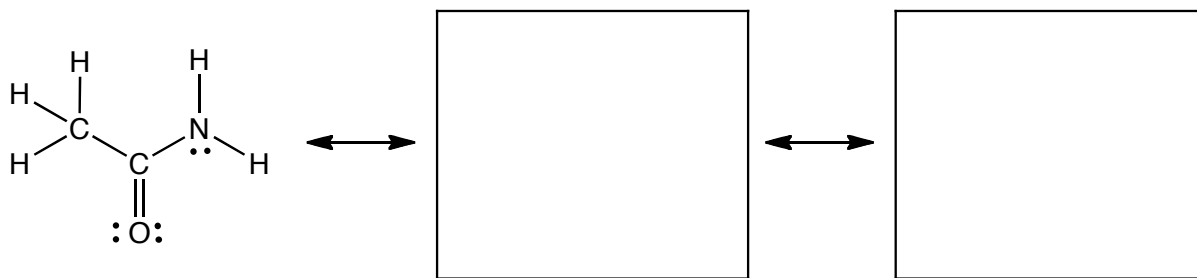
(compound name)

(exact name)

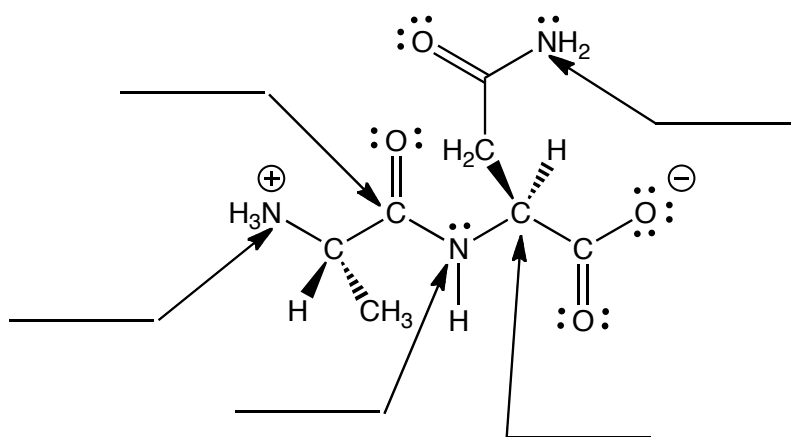


For the disaccharide of glucose on the left, draw a circle around any glucose residue that is/are a. Draw a box around any glucose residue that is/are b. Next, draw a box around the glycosidic bond linkage. Finally, circle all anomeric carbon atoms.

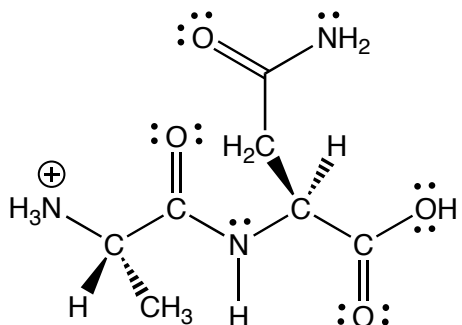
7. Draw the two most important resonance contributing structures of the amide shown below. Be sure to show all lone pairs and formal charges. You do not have to draw arrows on this one.



8. On the lines, indicate the hybridization state of each atom indicated by the arrows.



9. On the following structure circle all of the C-N bonds that DO NOT ROTATE.



For the above structure, is this the appropriate protonation state for pH 2.0, 7.0, or 10.0?

⇐ Notice This
