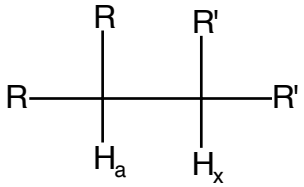
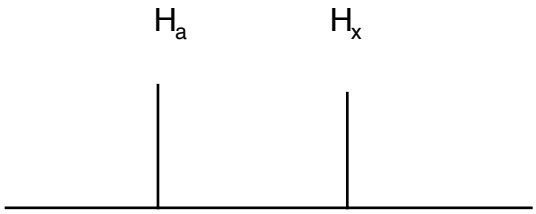
Problem 71, Chemistry 301X - 2006

(a) One might expect that a two-spin system of the following kind would show two lines, one for each different hydrogen. But, as a former US president once said, that would be wrong.

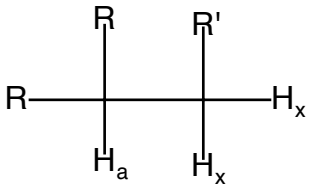




Remember that each *different* hydrogen - each hydrogen in a different molecular environment - resonates at a *different* frequency (energy), and that the spin of H_x (or of H_a) can have two values, + 1/2 or – 1/2. Now predict the NMR spectrum of the "AX" system shown above.

Get your answer checked!

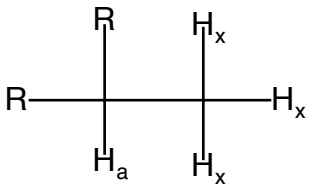
(b) Now predict the spectrum for the following "AX_2" system:



First catalog the possible spin combinations of two H_x hydrogens, then predict the spectrum.

Get your answer checked!

(c) Now do the same thing for "AX_3"



Finally, generalize: how many lines will appear when a hydrogen, H_a, is flanked by n adjacent equivalent hydrogens? Draw a molecule in which an H_a is flanked by four equivalent H_x's.