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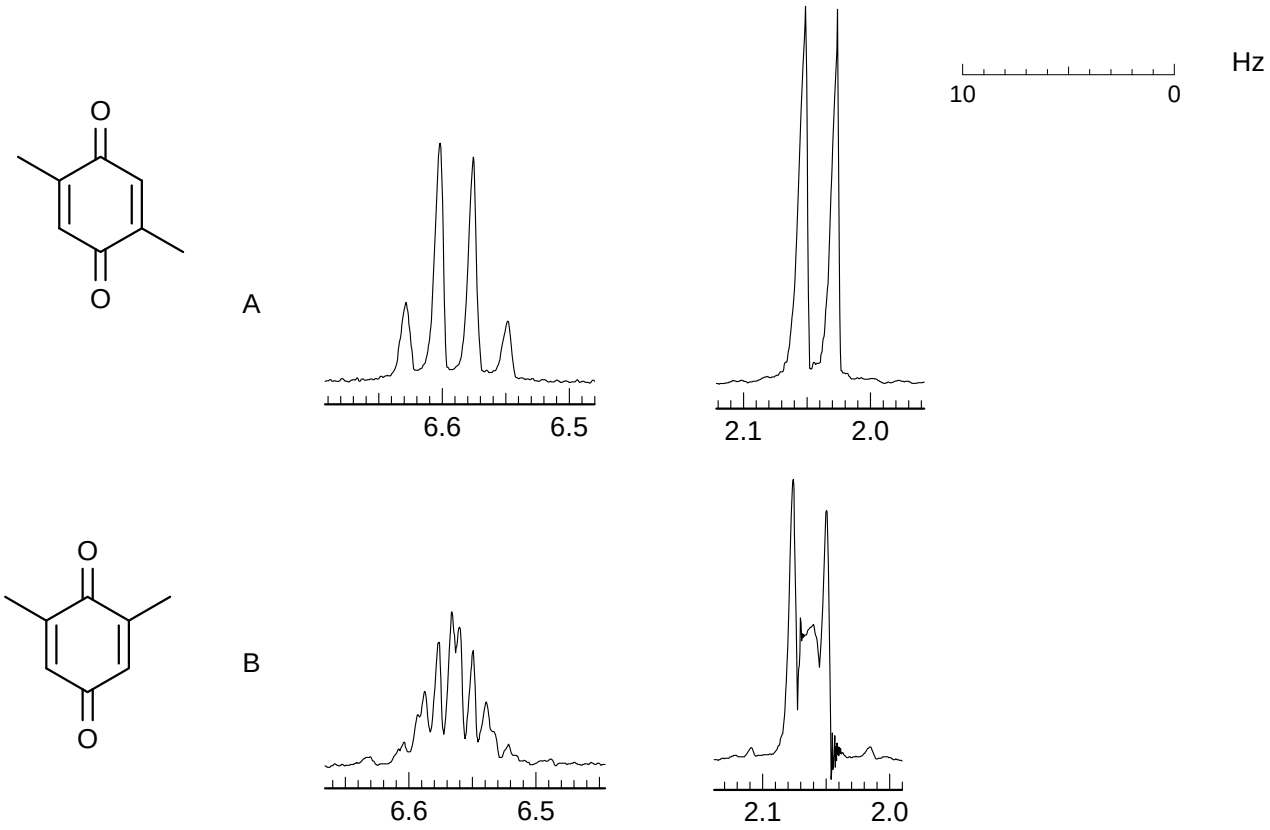

(a) What kind of patterns are these (e.g., ABMX)? _____

(b) Analyze the multiplets in spectrum A (interpret the coupling).

(c) Explain the origins of the very different appearance of the multiplets in spectrum B. Be specific and brief.

(d) Would you expect spectrum B to be more like A at 600 MHz? Explain.

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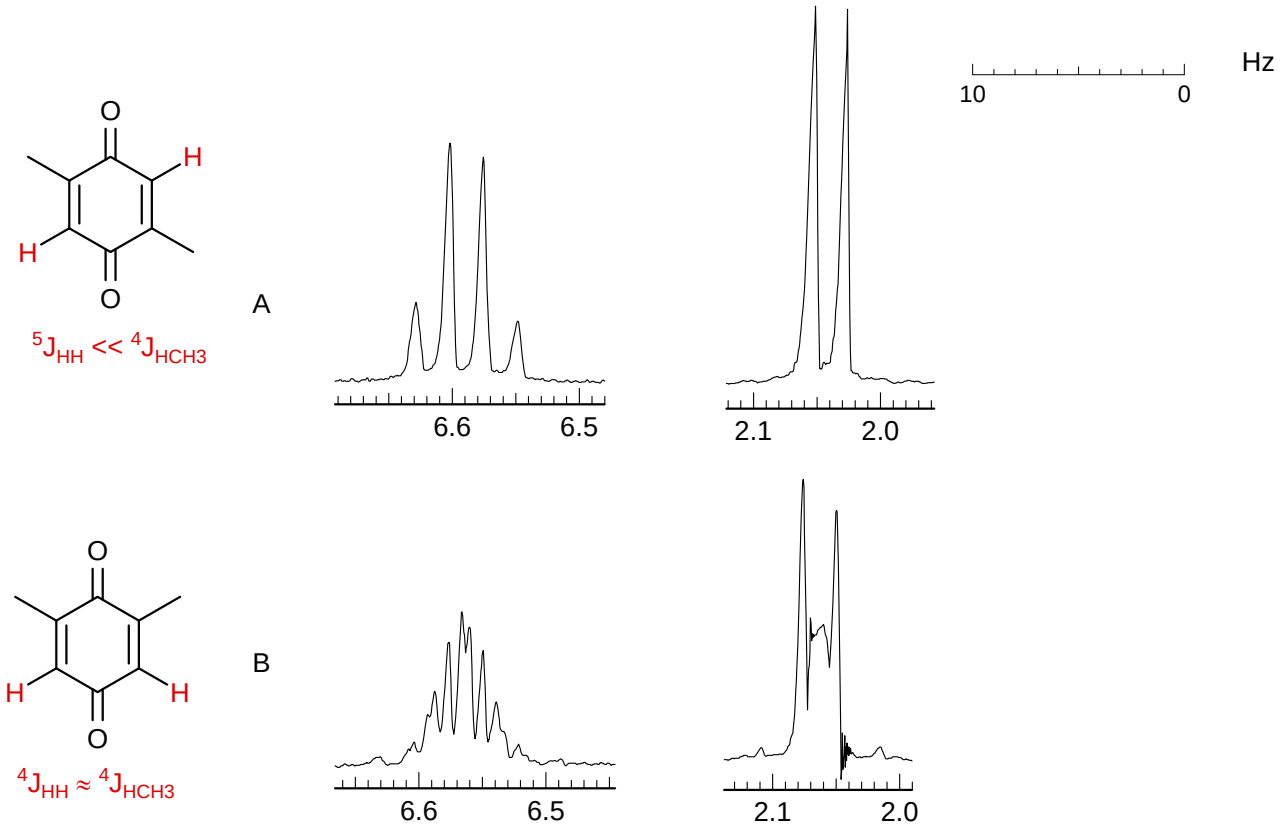

3 (a) What kind of patterns are these (e.g., ABMX)? $A_3A_3'XX'$

(b) Analyze the multiplets in spectrum A (interpret the coupling).

2

δ 2.04 d, ^4J = 1.6 Hz to vinyl proton

δ 6.59 q, ^4J = 1.6 Hz to methyl group

This is normal 4-bond allylic coupling

(c) Explain the origins of the very different appearance of the multiplets in spectrum B. Be specific and brief.

6

In B the two vinyl protons are coupled to each other, with an expected ^4J of 1.6 Hz ($^4J >> {}^5J$) and have zero chemical shift, so anything coupled to these protons such as the methyl group shows "virtual coupling" effects of the AA'XX' type.

In A the coupling between the vinyl protons is very small ($^5J_{XX'} = 0$) so the two CH_3-C=C-H systems do not interact, and a simple A_3X system results (could be called $(A_3X)_2$).

(d) Would you expect spectrum B to be more like A at 600 MHz? Explain.

4

No, these effects are field-independent - the $\Delta\delta_{XX'}$ would be zero at any field, and spectrum B would look exactly the same at 600 MHz as it does at 60 MHz (assuming the instrument could be tuned as well - tuning measured in Hz)