Problem R-03E. (C₈H₁₀)
75 MHz ¹³C NMR Spectrum in CDCl₃
Source: Aldrich Spectra Collection
**Problem R-03E.** Below are given the aliphatic carbons of $^{13}$C NMR spectra of 2-methylenebicyclo[2.2.1]heptene, and the $^{13}$C NMR spectrum of a mixture of stereoisomeric 2-ethylidenebicyclo[2.2.1]heptenes (complete spectra are shown on the following page). Your task is to assign some of the resonances and determine which isomer is which in the mixture of isomers. (Source: Aldrich Spectra Viewer).

(a) Assign the aliphatic signals of 1 by writing the $\delta$ values next to the appropriate carbons

(b) Assign the aliphatic signals of compounds 2 and 3 by writing the $\delta$ values next to the appropriate carbons

(c) Which isomer (2 or 3) is the major one? Briefly explain the basis for your assignment of structure. Be specific. Use the numbering scheme shown in your answer.
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In compound 3, C-3 should see a $\gamma$-effect and be upfield of C-3 in 1 and 2. The minor isomer has a C-3 chemical shift almost identical to that of 1, thus it must be 2. The major isomer is then 3. Similar argument for C-1, which should be upfield in 2 compared to those in 1 and 3. Chemical shifts for C4 and C-7 should be close in both isomers.