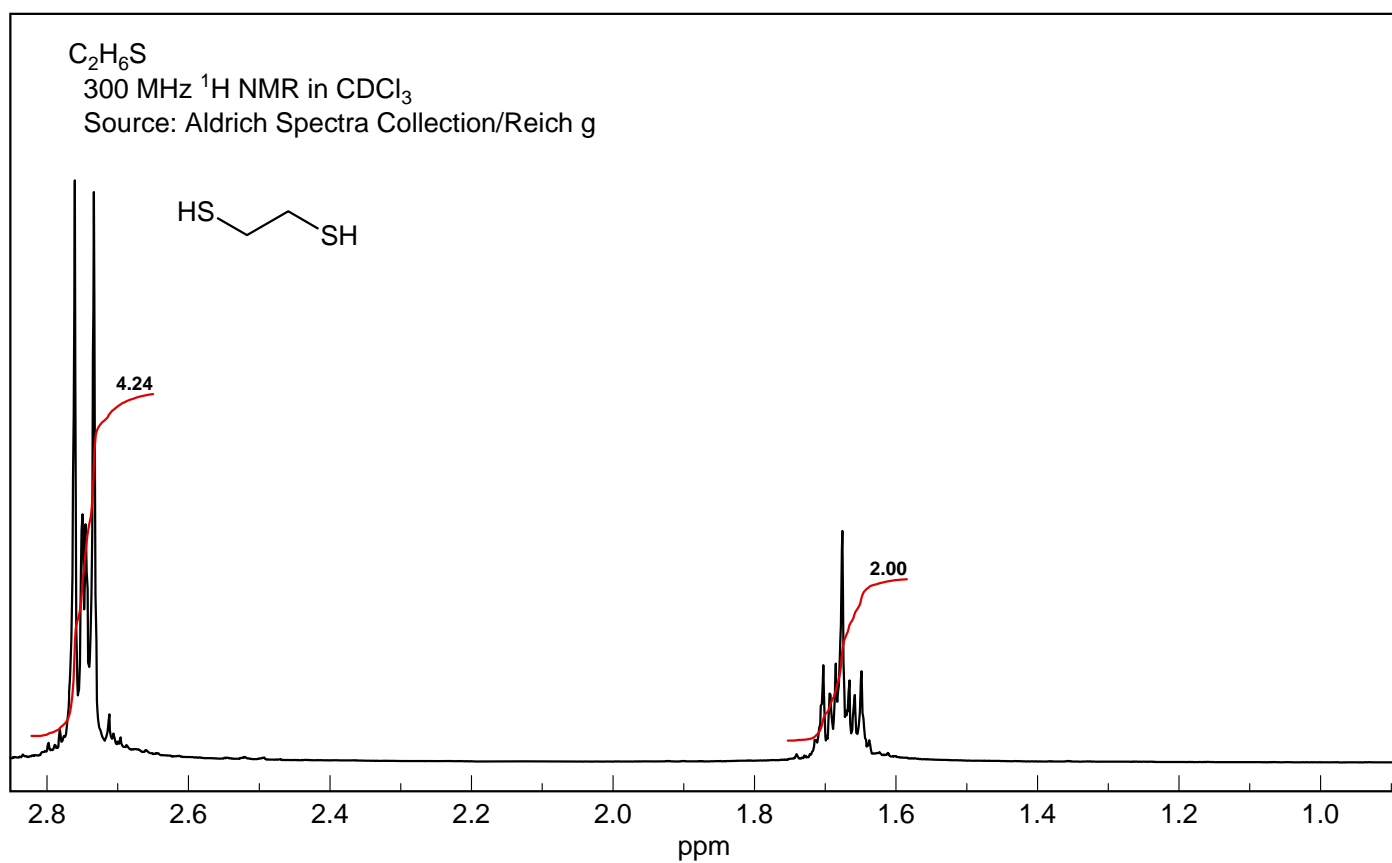
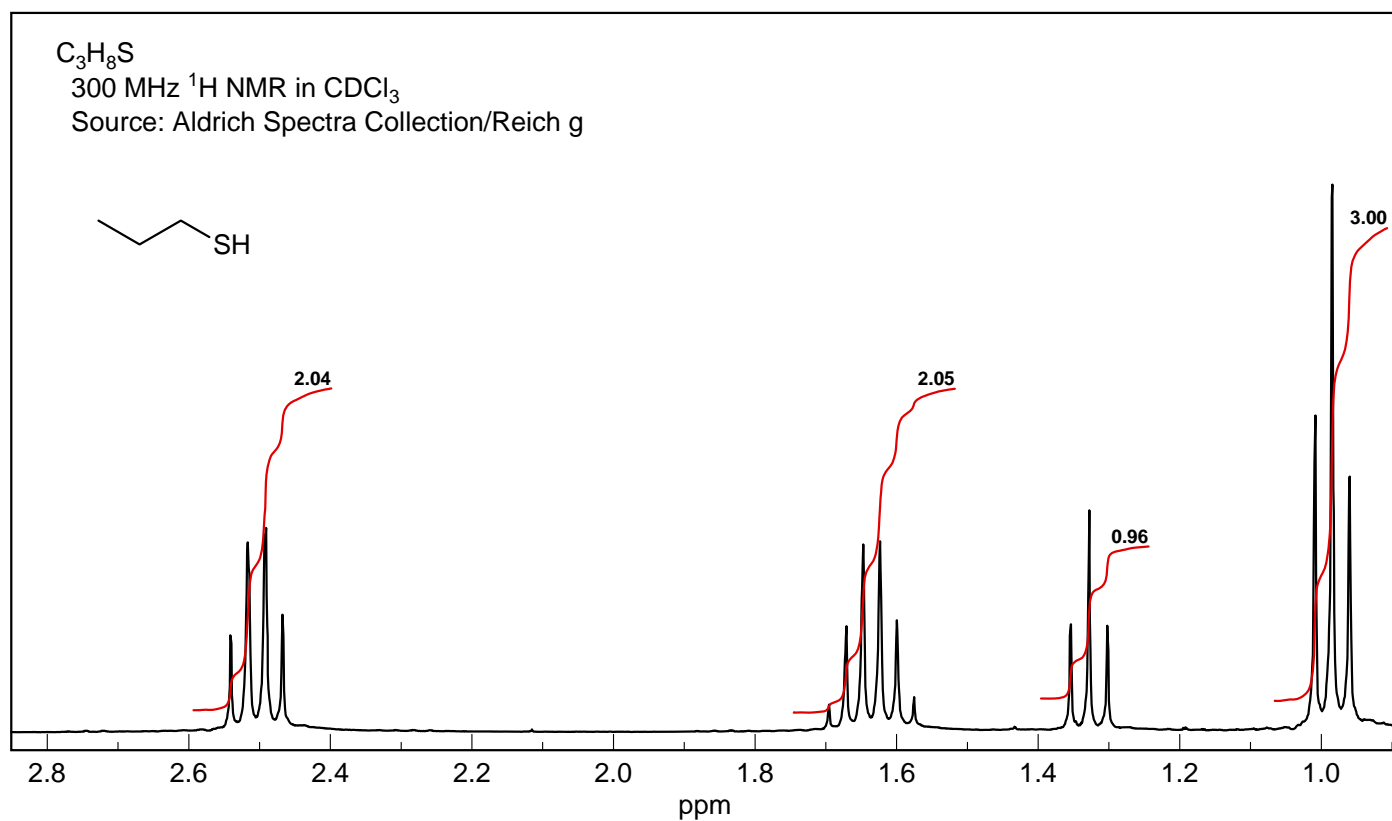


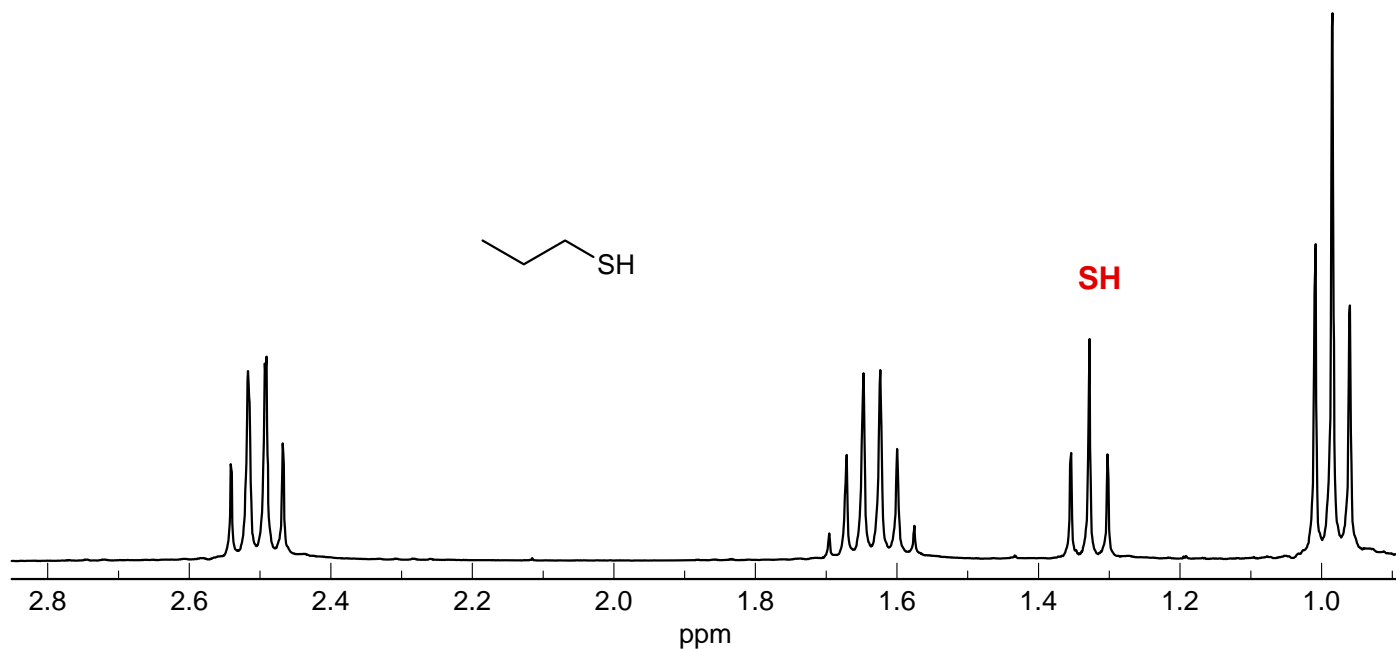
**Problem R-110.** Identify the SH protons in the two 300 MHz  $^1\text{H}$  NMR spectra ( $\text{CDCl}_3$ ) below, and explain the difference in their appearance (Source: Aldrich NMR Library).



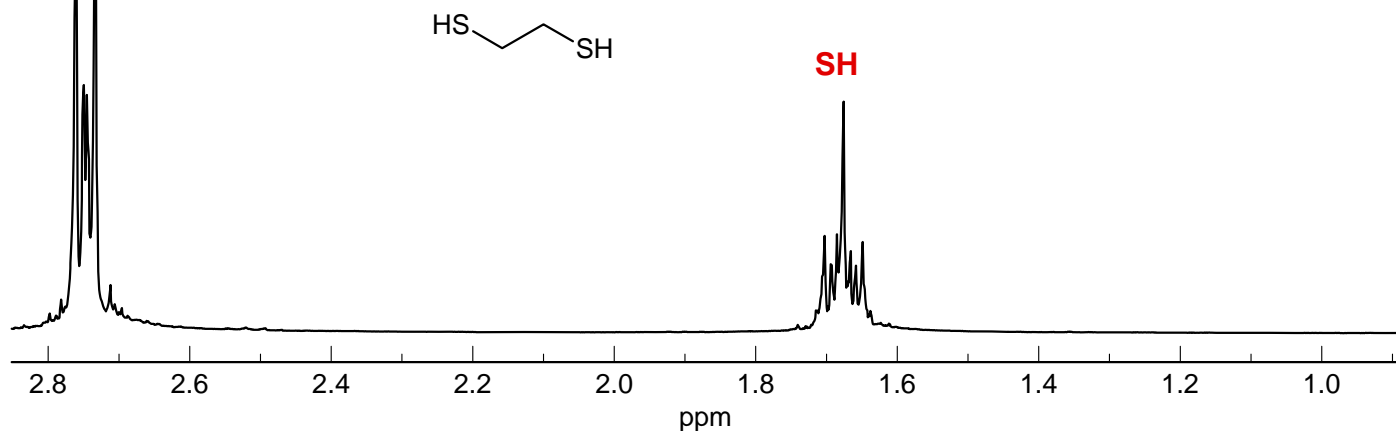
8

**Problem R-110.** Identify the SH protons in the two 300 MHz  $^1\text{H}$  NMR spectra ( $\text{CDCl}_3$ ) below, and explain the difference in their appearance (Source: Aldrich NMR Library).

2



2



In the top spectrum the SH proton is coupled to the  $\text{CH}_2$  protons, which are well separated from their other coupling partner, the second  $\text{CH}_2$  group. So the pattern is entirely first-order and the SH proton is a simple triplet.

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For the bottom spectrum the spin system is  $\text{AA}'\text{BB}'\text{B}''\text{B}'''$  - so decidedly second order. Specifically, the B protons ( $\text{CH}_2\text{CH}_2$ ) are strongly coupled, so the A protons (SH) are second order - an example of virtual coupling.