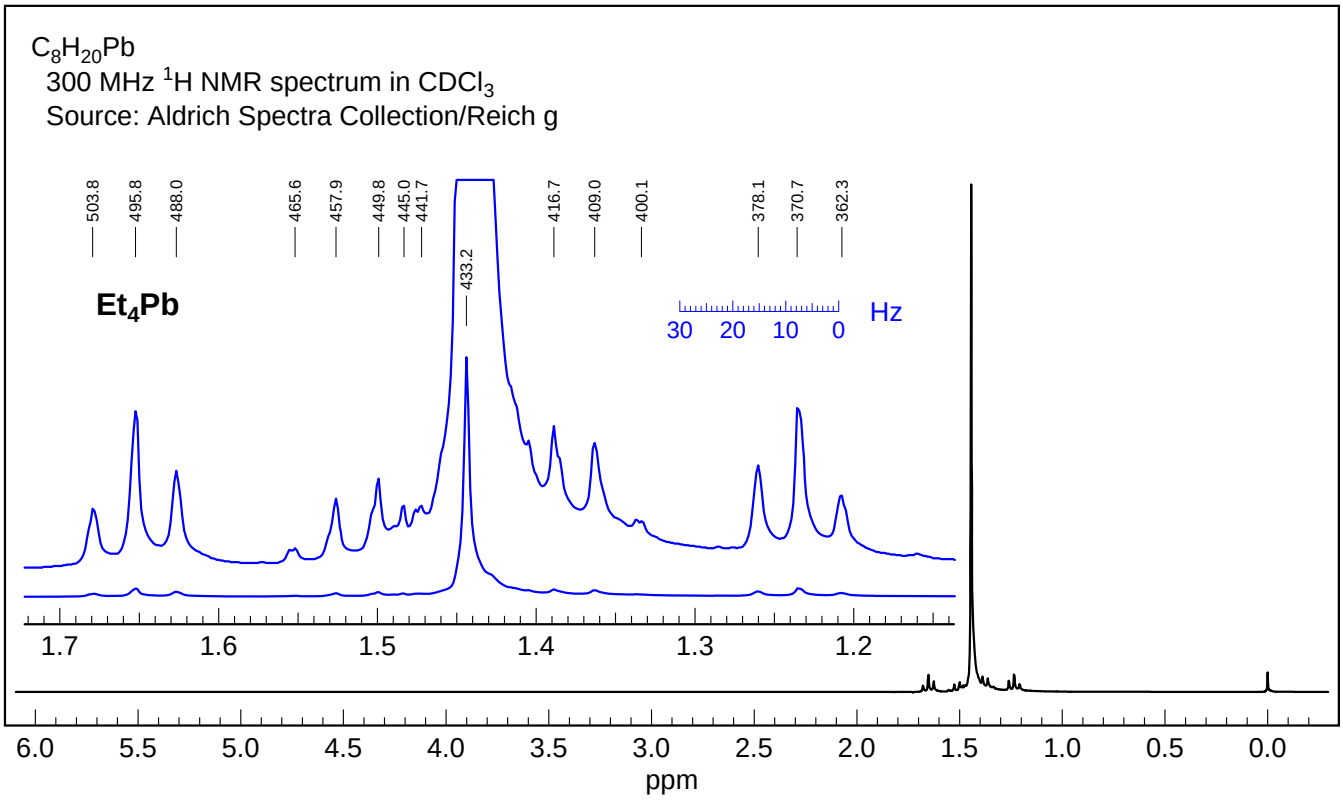
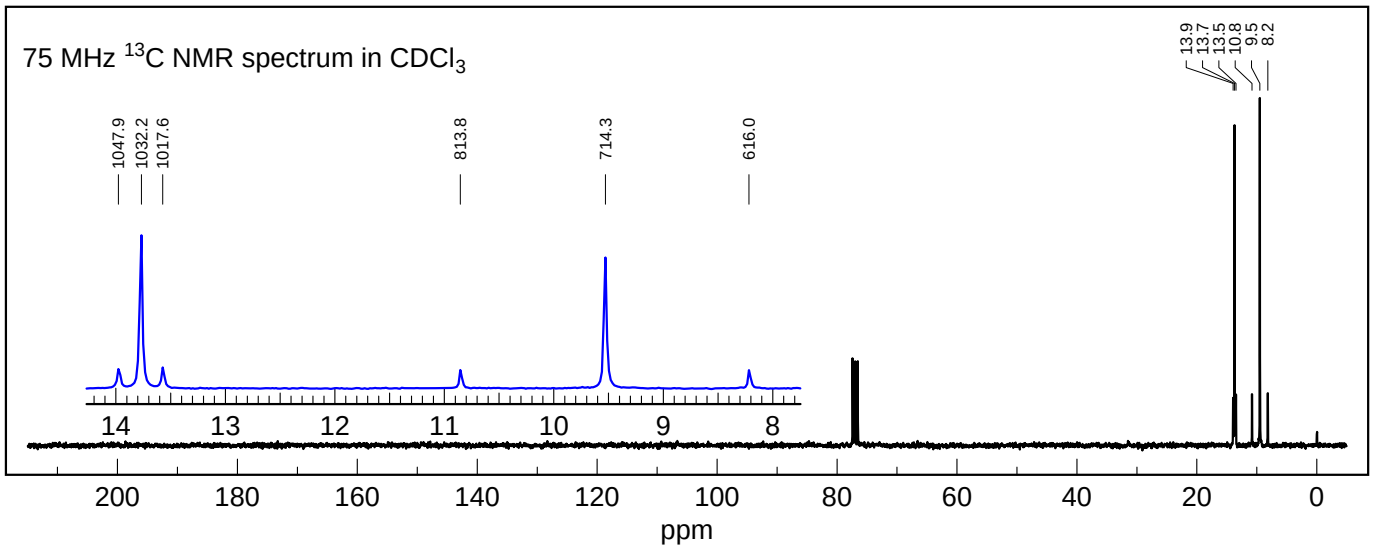
Exercise: Determine all available couplings (J_{HH}, J_{HPb}, J_{CPb}), and measure the chemical shift difference between the CH_3 and CH_2 protons (the CH_3 and CH_2 protons of the A_3B_2 system are too close together to resolve in the central peak).



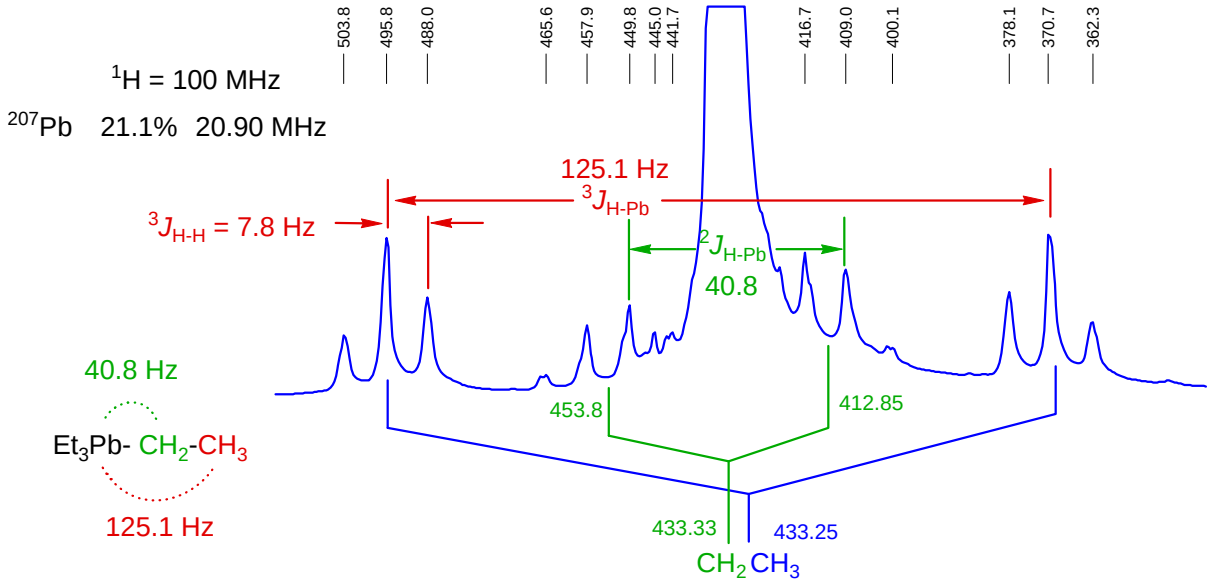


PLT 125.1Hz

Answer

Lead has one spin 1/2 isotope, ^{207}Pb, which is 21.1% abundant (so satellites are easily seen). The central peak is a singlet due to the superposition of the CH_3 and CH_2 signals, providing almost no structural information. The satellites are readily identified, and allow analysis of the coupling and shifts.

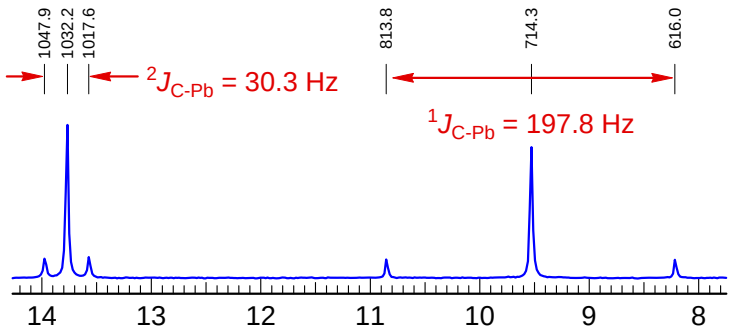
Problem R-21M $C_8H_{20}Pb$
300 MHz ^1H NMR spectrum in $CDCl_3$
Source: Aldrich Spectra Collection/Reich



Although the central peaks for the CH_2 and CH_3 protons are almost superimposed so that neither the chemical shift nor the coupling between them can be measured, the satellites are well separated. Thus the chemical shift difference between CH_2 and CH_3 protons is the difference between the centers of the two sets of satellites, about 0.1 Hz. Of course, such a small effect could also be an isotope shift.

It is interesting to note that the NMR spectrum pf Et_4Pb at 300 MHz shown here looks identical to the one at 40 MHz (Narasimhan, Rogers) this is because the chemical shift between the protons is almost 0, and all of the line separations are governed by coupling constants which are field independent.

The ^{13}C NMR spectrum:



PLT 125.1Hz