1. For each of the following 7 $^1$H-NMR spectra (300 MHz) of compounds A-G, analyze each by constructing a table that contains
   a) Chemical shift ($\delta$) for each set of equivalent Hs
   b) integral (in some unit of measure, usually mm)
   c) relative number of hydrogens
   d) multiplicity for each different signal.
   e) assign signals to likely groups (substructures)

   Propose a structure using this data and label each H, from your table, on your structure.

2. Give a structure or structures consistent with each of the following sets of $^1$H-NMR data. Assign the signals to hydrogens in your structures.

   a) $C_3H_5Cl_3$
   - $a$ triplet, $\delta$ 4.52, 1H
   - $b$ doublet, $\delta$ 6.07

   b) $C_6H_{12}O_2$
   - $a$ singlet, $\delta$ 1.50, 9H
   - $b$ singlet, $\delta$ 2.01, 3H

   c) $C_9H_{11}Br$
   - $a$ quintet, $\delta$ 2.15, 2H
   - $b$ triplet, $\delta$ 2.75, 2H
   - $c$ triplet, $\delta$ 3.38, 2H
   - $d$ br. singlet, $\delta$ 7.22, 5H

   d) $C_4H_8Cl_2$
   - $a$ doublet, $\delta$ 1.60, 3H
   - $b$ triplet, $\delta$ 2.15, 2H
   - $c$ triplet, $\delta$ 3.72, 2H
   - $d$ multiplet, $\delta$ 4.27, 1H

   e) $C_3H_5ClF_2$
   - $a$ triplet, $\delta$ 1.75, 3H
   - $b$ triplet, $\delta$ 3.63, 2H (remember that F (I=±½) can couple with H)

3. Give a structure or structures consistent with each of the following sets of $^{13}$C-NMR data. Assign the signals to the carbons in your structures.

   a) $C_3H_2Cl_3$
   - $a$ triplet, $\delta$ 45.3
   - $b$ doublet, $\delta$ 59.0

   b) $C_4H_6Br_2$
   - $a$ quartet, $\delta$ 10.9
   - $b$ triplet, $\delta$ 29.0
   - $c$ triplet, $\delta$ 35.5
   - $d$ doublet, $\delta$ 54.3

   c) $C_3H_2Br$
   - $a$ triplet, $\delta$ 32.6
   - $b$ triplet, $\delta$ 118.8
   - $c$ doublet, $\delta$ 134.2

4. Propose a structure or structures consistent with the $^{13}$C-NMR spectrum shown for compound H. Assign the signals to the carbons in your structure(s).

5. Compound J, molecular formula $C_5H_{10}O$, readily decolorized Br$_2$ in CCl$_4$, and is converted by H$_2$/Ni into compound K, molecular formula $C_5H_{12}O$. Following is the $^1$H-NMR spectrum of compound J. The $^{13}$C-NMR spectrum of J shows signals at 146.12, 110.75, 71.05, and 29.38. Deduce the structural formulas of compounds J and K and assign all proton and carbon signals to the appropriate atoms in your proposed J structure.
A \( \text{C}_4\text{H}_6\text{O}_2 \)

B \( \text{C}_4\text{H}_6\text{O}_2 \)

C \( \text{C}_4\text{H}_6\text{O}_2 \)
**D** (C₇H₁₂)

![Graph of C₇H₁₂](image)

**E** (C₆H₁₂)

![Graph of C₆H₁₂](image)

**F** (C₆H₁₂)

![Graph of C₆H₁₂](image)

**G** (C₆H₁₂)

![Graph of C₆H₁₂](image)
**H (C₆H₁₂O):** Strong IR band at 1715 cm⁻¹
(a) is the normal broadband decoupled spectrum, and (b) is the DEPT spectrum.