1. The IR and $^{13}$C NMR of a sample with a molecular formula of C$_7$H$_{12}$O$_4$ is shown below. What is the compound?
2. Molecular formula is $\text{C}_6\text{H}_{10}$ and the IR and $^{13}\text{C}$ NMR are given below. What is the structure?
3. The $^1$H NMR with relative integration values and IR with a peak at 1719 cm$^{-1}$ for a compound with a molecular formula of C$_9$H$_{10}$O$_2$ is shown below. What is the structure?
4. Following are $^{13}$C NMR of Isomers of C$_{10}$H$_{14}$. Each display similar 1H NMR spectra with a quartet at $\sim$2.6 ppm and a triplet at $\sim$1.1 ppm (in addition to other peaks). What is the structure of each?

A.

B.
C.
5. Compound has formula C₆H₁₂O₂. The ¹H NMR shows two singlets at 3.6 and 1.2 ppm and the IR shows a peak at 1740 cm⁻¹. What is the structure?
6. Given the MS, $^1$H and $^{13}$C NMR of an unknown compound, what is the structure?
Keys

1) 
\[ \text{HO-C}_3\text{H}_4\text{COOH} \]

2) 
\[ \text{CH}_3\text{C}≡\text{CH} \]

3) 
\[ \text{PhCOOCH}_3 \]

4) 
Top
\[ \text{Ph} \]

Middle
\[ \text{PhCH}_2\text{CH} \]

Bottom

5) 
\[ \text{CH}_3\text{COOCH}_3 \]

6) 
\[ \text{Ph} \text{Br} \]
1) The $^1$H NMR spectra of three isomers with molecular formula $C_5H_{10}O$ are shown below. Based on the $^1$H NMR spectra give the structures of the isomers.
2) The $^1$H NMR spectra of three isomers with molecular formula $C_5H_{10}O_2$ are shown below. Based on the $^1$H NMR spectra give the structures of the isomers.
3) The $^1$H NMR spectra of three isomers with molecular formula $C_6H_{12}O_2$ are shown below. Based on the $^1$H NMR spectra give the structures of the isomers.
Keys:

**Problem 1**
Molecular formula: C₅H₁₀O
a)

b)

c)

**Problem 2**
Molecular formula: C₅H₁₀O₂
a)

b)

**Problem 3**
Molecular formula: C₆H₁₂O₂
a)

b)

c)