1. a) How many signals are present in the proton NMR spectra of each of the following compounds? Count similar but theoretically different benzene ring protons as different.
   b) How many signals are present in the C-13 NMR spectrum of each?

   CH₃CH₂CH₂OCH₂CH₃
   a) 5
   b) 5

   CH=CH-C-CH₃
   a) 6
   b) 8

2. a) What splitting pattern (singlet, doublet, triplet, etc.) is observed for each of the underlined proton(s)? b) What is the m/z ratio for the molecular ion for each of the compounds? (Atomic masses: H, 1; C, 12; O, 16; Br, 80)

   (CH₃)₂CHBr
   a) septet
   b) 123

   C₃H₇Br
   a) singlet
   b) 134

   C₁₀H₁₄

3. Which of the following indicated protons gives a signal with the highest δ value (most deshielded)? Which gives a signal with the lowest δ value? What is the m/z ratio for the molecular ion?

   CH₃CH₂C-H
   a) 1.2
   b) 2.1
   c) 9.5 ppm

   highest δ value
   lowest δ value
   m/z ratio
   C₃H₆O

4. Identify each of the following compounds from the given IR and proton NMR spectra (s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet).
   a) C₃H₇Br
      NMR: doublet, δ 1.7, 6H
      septet (7 peaks), δ 4.3, 1H

   b) C₇H₈O
      IR: broad peak in 3200-3550 cm⁻¹ region
      NMR: s, δ 2.4, 1H
      s, δ 4.6, 2H
      m, δ 7.3, 5H

   c) C₈H₈Br
      NMR: d, δ 2.0, 3H
      q, δ 5.2, 1H
      m, δ 7.4, 5H
5. Predict proton and C-13 NMR spectra for the following compound. Also calculate m/z ratio for its molecular ion (radical cation). Atomic masses: H=1, C=12, N=14, O=16.