Propose a structure in the space provided that fits the data presented. Your final answer must be clearly shown within the space.

1) $\text{C}_8\text{H}_9\text{BrO}$

**H NMR**

- 7.4 (2H, doublet)
- 7.2 (2H, doublet)
- 4.2 (1H, quartet)
- 2.5 (1H, broad singlet)
- 1.4 (3H, doublet)

**Broadband decoupled C NMR**

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<table>
<thead>
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<tbody>
<tr>
<td>144.7</td>
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<tr>
<td>131.4</td>
<td>69.6</td>
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<tr>
<td>127.1</td>
<td>25.2</td>
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</table>

**IR:** 3500 cm$^{-1}$ (broad), 1100 cm$^{-1}$

2) $\text{C}_9\text{H}_{10}\text{O}_2$

**H NMR**

- 9.8 (1H, singlet)
- 7.8 (1H, triplet)
- 7.5 (1H, doublet)
- 7.4 (1H, singlet)
- 7.35 (1H, doublet)
- 3.8 (2H, quartet)
- 1.3 (3H, triplet)

**Broadband Decoupled C NMR**

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<tbody>
<tr>
<td>191.1</td>
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<td>137.7</td>
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<td>114.2</td>
<td>64.6</td>
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<tr>
<td>14.4</td>
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</tbody>
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**IR:** 1697 cm$^{-1}$, 1100 cm$^{-1}$
Predict the number of signals in the NMR spectrum in the following compound:

![Chemical structure](image)

A  C NMR ________________

B  H NMR ________________

Draw a structure of a molecule that meets the following descriptions:
Molecular formula C₄H₈Br₂O
H NMR- only two triples
C NMR only two signals

Draw a structure of a molecule with the formula C₅H₈O that would show a characteristic IR absorption at around 1700 cm⁻¹

Draw a structure of a molecule with the formula C₄H₇N that would show a characteristic IR absorption at around 2240 cm⁻¹ (no other significant peaks observed beyond 3050 cm⁻¹)
2. (6 points) Write a complete, stepwise mechanism for the following transformation. Use curved arrows to denote electron flow. Show only one possible termination step.

\[
\text{CH}_4 + \text{Br}_2 \xrightarrow{hv} \text{CH}_3\text{-Br} + \text{HBr}
\]

Multi-step synthesis
MORE SPECTROSCOPY:

C₉H₁₀O compound has a strong infrared absorption at 1720 cm⁻¹. Its ¹H NMR spectrum has signals at δ 2.8 (mult., 4H), 7.3 (s, 5H) and 9.8 (t, 1H) ppm. Its ¹³C NMR spectrum shows seven lines at δ200, 138, 129, 128, 125, 35 and 30 ppm. Suggest a structure for this compound.

C₅H₁₀O₂ compound shows a strong infrared absorption at 1100 cm⁻¹, but no absorption at 3300 to 3400 cm⁻¹. Its ¹H NMR spectrum has sharp singlet peaks at δ1.3 and 4.0 ppm (intensity ratio 3:2). Its ¹³C NMR spectrum shows three lines at δ 98, 68 and 20 ppm. Suggest a structure for this compound.

C₉H₁₀O₂ compound has strong infrared absorption at 1690 and 1100 cm⁻¹. Its ¹H NMR spectrum has sharp singlet peaks at δ 2.8 and 3.8 ppm (3H each) and two doublets at δ 6.9 and 7.8 ppm (2H each). Its ¹³C NMR spectrum shows seven lines. Suggest a structure for this compound.

C₉H₁₀O₂ compound has strong infrared absorption at 1695 cm⁻¹. The ¹H NMR spectrum has five sets of lines: a triplet at δ1.3(3H), a quartet at δ>4.1(2H), a doublet at δ7.0(2H), a doublet at δ7.8(2H) and a singlet at δ9.8(1H) ppm. Suggest a structure for this compound.

C₄H₈O₃ compound has strong infrared absorption at 2500 to 3300 cm⁻¹ and 1710 cm⁻¹. The ¹H NMR spectrum has four signals: a doublet at δ1.2(3H), a quartet at δ4.5(1H), a singlet at δ3.6(3H) and a singlet at 12.5 ppm. The ¹³C NMR spectrum has four signals at δ177, 70, 54 and 18 ppm. Suggest a structure for this compound.