# Answers to Additional Problems
## Chapter 13

### Additional Practice Problems

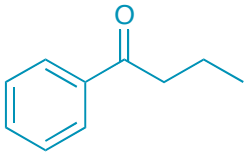
1. How many degrees of unsaturation does a molecule with the formula $C_{11}H_{13}N_2Cl$ have?

   **6**

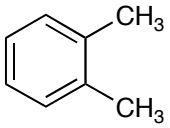
2. Which of the following sets of data would match the proton NMR of ethanol ($CH_3CH_2OH$)?

   **a) 1.2 ppm (triplet, 3H); 2.6 ppm (singlet, 1H); 3.8 ppm (quartet, 2H)**
   b) 1.2 ppm (quartet, 3H); 2.6 ppm (singlet, 1H); 3.8 ppm (triplet, 2H)
   c) 1.2 ppm (singlet, 3H); 2.6 ppm (singlet, 1H); 3.8 ppm (singlet, 2H)

3. Use the following $^1H$ and $^{13}C$ NMR data to determine the structure of a molecule with the molecular formula $C_{10}H_{12}O$.



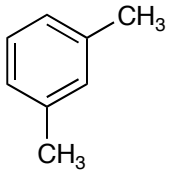

4. The three compounds shown below, ortho-, meta-, and para-xylene have very different $^{13}C$ NMR spectra. Match the structures with the correct spectra.




ortho-xylene

**A**

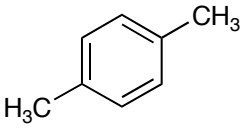
**Spectrum 2**




meta-xylene

**B**

**Spectrum 3**




para-xylene

**C**

**Spectrum 1**