25. How many signals do you expect to see in a $\text{^{13}C}$ NMR spectrum of the following compounds?

![Molecular structures of compounds](image)

26. Using the following DEPT spectral data, how many primary, secondary, tertiary, and quaternary carbons do you expect in these compounds? Based on the chemical shifts of the signals, what functional groups do you believe to be contained in the structure? What is the HDI for each molecule? What can this tell you about the structure?

a. Molecular formula: $\text{C}_9\text{H}_{11}\text{NO}_2$

$\text{^{13}C}$ NMR: 165.9, 152.7, 130.7, 114.1, 60.9, 14.1

DEPT 135: 130.7(+), 114.1(+), 60.9(-), 14.1(-)

DEPT 90: 130.7(+), 114.1(+)

b. Molecular formula: $\text{C}_{17}\text{H}_{17}\text{Cl}_2\text{N}$

$\text{^{13}C}$ NMR: 145.5, 139.6, 138.0, 132.5, 130.9, 130.7, 129.4, 127.7, 126.4, 126.0, 125.1, 124.9, 59.9, 44.7, 34.6, 27.7, 21.9

DEPT 135: 130.7(+), 129.4(+), 127.7(+), 126.4(+), 126.0(+), 125.1(+), 124.9(+), 59.9(+), 44.7(+), 34.6(+), 27.7(-), 21.9(-)

DEPT 90: 130.7(+), 129.4(+), 127.7(+), 126.4(+), 126.0(+), 125.1(+), 124.9(+), 59.9(+), 22.7(+)

27. Suppose you are synthesizing trinitrobenzenes to be used as potential explosives. You have three possible isomers that could be made and wish to distinguish between them. What are the possible isomers? How many $\text{^{13}C}$ signals do you expect to see for each? Could $\text{^{13}C}$ NMR be used to distinguish between them? Why or why not?

28. Describe how the signals for each of the carbons would appear in a typical $\text{^{13}C}$ NMR spectrum, a DEPT-90 spectrum, and a DEPT-135 spectrum for each compound below. Also include the approximate chemical shift.

![Molecular structures of compounds](image)

29. Determine the structure of the compound based on the following information.

$\text{C}_{10}\text{H}_{10}\text{O}_2$

IR ($\text{cm}^{-1}$): 3030, 2990, 2950, 1720, 1640, 1500, 1450, 1380, 980, 710, 690

EI-MS ($m/z$): 162, 131 (base peak), 103, 77, 51
Note: only reported if >\((20\%)\) of base peak.

\(\text{^1H} \) (ppm [splitting, integration]): 3.80 (s, 3 \(\text{H}\)); 6.31 (d, 1 \(\text{H}\)); 7.33 (t, 1 \(\text{H}\)); 7.38 (d, 1 \(\text{H}\)); 7.54 (d, 2 \(\text{H}\))

Note: some peaks overlap in the spectrum, it has been simplified for you.

\(\text{^{13}C} \) (ppm): 52.0, 115.1, 127.9, 128.5 (2 carbons), 128.6 (2 carbons), 135.2, 143.6, 166.5

DEPT-135: 52.0(+), 115.1(+), 127.9(+), 128.5(+, 2 carbons), 128.6(+, 2 carbons), 135.2(+), 143.6(+), 166.5(+)

DEPT-90: 115.1(+), 127.9(+), 128.5(+, 2 carbons), 128.6(+, 2 carbons), 143.6(+)

30. Solvent peaks often show up in NMR spectra as impurities, because the solvent was not \((100\%)\) deuterated, or through a proton exchange between the compound and the solvent. For each of the common, undeuterated solvents, determine the splitting pattern and approximate chemical shift for the protons. For carbon-containing solvents, also determine the approximate chemical shift for the carbon(s).