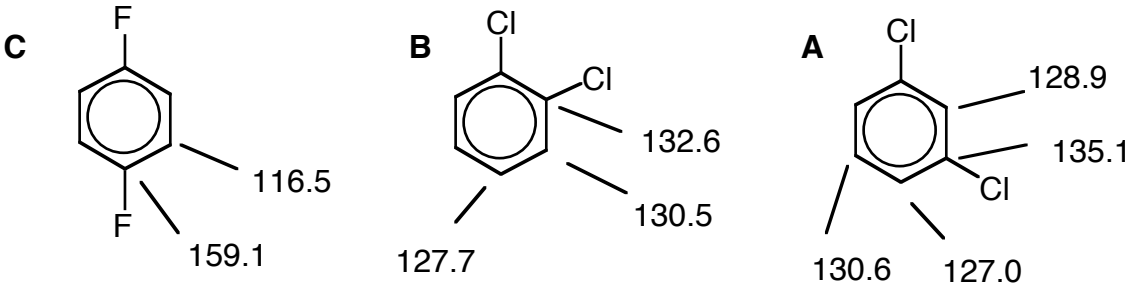
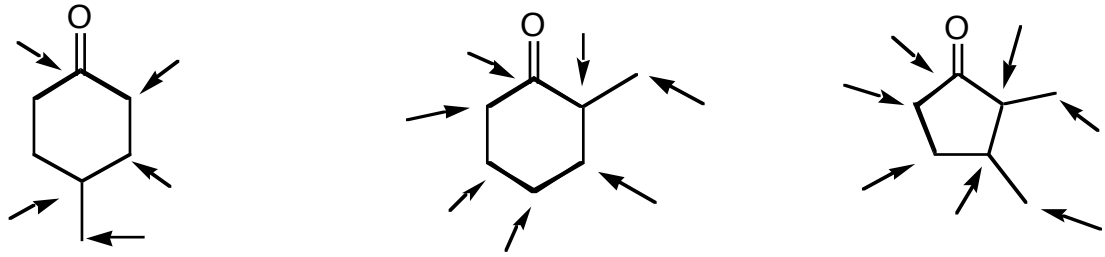
Answers to Problem 76, Chemistry 301X - 2006

This should be an easy one. There is no need to think about complete assignments of the signals. Instead one takes advantage of symmetry. *p*-Difluorobenzene has only two different carbons and must have spectrum **C**. Similarly, *o*-dichlorobenzene has three different carbon atoms and must have spectrum **B**. The remaining isomer, *m*-dichlorobenzene has four different carbons and must have spectrum **A**. The complete assignments are shown below, but symmetry alone is enough to do the structural assignments.



How far can we get using symmetry? The answer is "somewhere, but not all the way". We can tell which isomer is 4-methylcyclohexanone, but that's all. 4-Methyl-cyclohexanone has only five different carbons whereas both 2-methylcyclohexanone and 2,3-dimethylcyclopentanone have seven different carbons. We can tell which isomer is 4-methylcyclohexanone, but we can go no further than this.



five signals seven signals seven signals

An examination of the coupled ^{13}C NMR spectra should allow us to distinguish the last two compounds. For example, 2-methylcyclohexanone will show one ^{13}C signal as a quartet - the methyl carbon attached to three hydrogens, whereas 2,3-dimethyl-cyclopentanone will show two such quartets.