Reading guide and suggested problems for Chapter 4

Chapter 4: Symmetry and Group Theory. This chapter introduces symmetry, something you encounter in daily life but may not think of a lot when it comes to chemistry and molecules. Symmetry and group theory help us understand the properties of molecules including their infrared spectra, their bonding (molecular orbitals, Ch 5), among other things.

Learning goals:
1) Identify symmetry elements and determine point groups of objects and molecules.
2) Understand how to use character tables to determine molecular properties.
3) Predict the infrared spectrum of a molecule based on its point group.
--
Suggested reading

4.1: Symmetry operations. This section introduces all of the basic symmetry elements/operations that an object or molecule can possess including: identity (E), proper rotation (C_n), reflection (σ), inversion (i), and improper rotation (S_n).

4.2, 4.2.1, 4.2.2: Point groups. Every molecule has a set of symmetry operations that define it; this set is called a point group. These sections provide the step-by-step process that allows you to determine the point group of a molecule.

4.3: Properties and Representations of Groups. This provides a nice introduction about the properties of a point group. Table 4.6 is especially informative.

4.3.1, 4.3.2: These two sections describe the matrices that help define the symmetry operations of a molecule. ***You are NOT responsible for this material***, however this provides background information about the numbers that are included in character tables.

4.3.3: Character tables: You ARE responsible for this material. This section describes what a character table is and the properties of a character table. Do not be intimidated by the matrices if they confuse you, ultimately we will just use the final character tables to analyze our molecules.

4.4, 4.4.1, 4.4.2: Examples and applications of Symmetry. These sections describe how you can use point groups and character tables to determine 1) the chirality of a molecule and 2) the IR and Raman stretches in a molecule. The examples provided in 4.4.2 should be especially helpful to guide you through calculating molecular vibrations.

--
Suggested homework problems: PRACTICE MAKES PERFECT with symmetry!
4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.10, 4.11, 4.12, 4.13

4.20a, 4.21a, 4.22, 4.23, 4.24, 4.25, 4.26, 4.27, 4.28, 4.29, 4.30, 4.31

Challenge questions: 4.32, 4.33, 4.34, 4.35

4.39, 4.40, 4.41