I. Lewis Dot Structures and VSEPR Theory

Given the formula for a molecule, you should be able to:

1. Produce the best Lewis Dot representation for that molecule, including resonance structures.

2. Determine the formal charge on each atom of your structure(s).

3. Indicate the correct molecular geometry and symmetry. *Extra Credit: identify the molecular point group.*

4. Determine whether it is polar or nonpolar.

5. Specify the direction of the dipole moment.

II. Vibrational Spectroscopy: Diatomic Molecules

For a diatomic molecule, you should be able to:

1. Calculate a molecule's vibrational stretch frequency (ν) from its force constant and reduced mass.

2. Determine if the molecule has a dipole moment. If it does, its vibrational stretch will appear in the IR spectrum, and you should be able to calculate the energy and wavelength of the infrared photon that will excite the vibrational stretch.

3. If the molecule does not have a dipole moment, its vibrational stretch will appear in the Raman spectrum, and you should be able to calculate the energy and wavelength of the Raman scattered photons *(Stokes and Anti-Stokes)* from an input light beam.

II. Vibrational Spectroscopy: Polyatomic Molecules

For a polyatomic molecule, you should be able to:

1. Calculate the number of vibrational modes in a given molecule *(3N-6 for nonlinear molecules, 3N-5 for linear molecules)*.

2. Determine if particular vibrational mode is infrared-active. *(Is there a dipole moment change?)*

3. Extra Credit: use a Character Table to identify whether a vibrational mode is infrared and Raman active.

III. Valence Bond Theory

You should be able to:

1. Sketch the Pauling hybrid orbitals: sp, sp^2, and sp^3

2. Identify the pi bonds in a polyatomic molecule.

3. Identify the possible isomers of a polyatomic molecule that contains pi bonds, and determine which isomers have a permanent dipole moment.

4. Understand the difference between an isomer and a conformer.