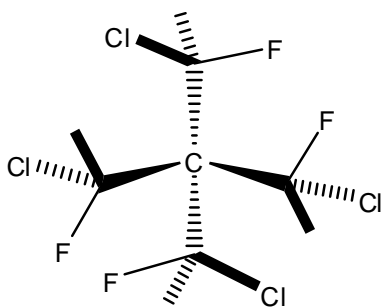
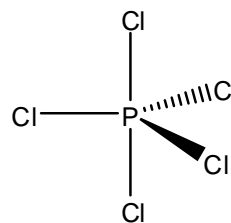
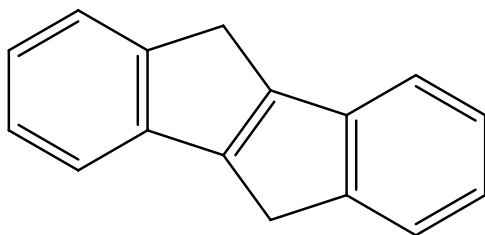
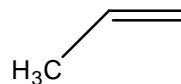
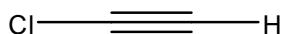
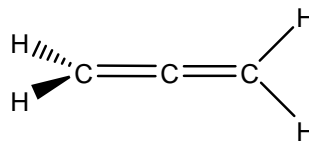
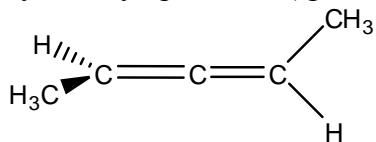


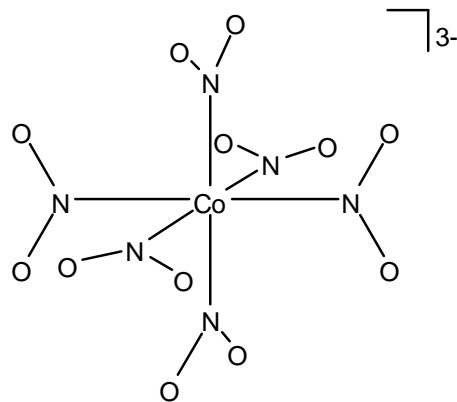
Chem 175/275  
Problem Set #1

Spring 2009  
Due: April 16th

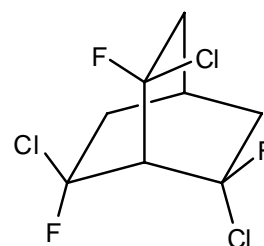
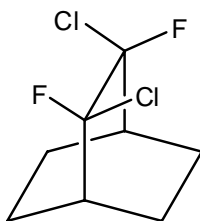
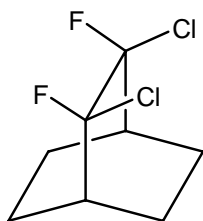
1) (3 points each) Determine the point groups of the following molecules and sketch all their symmetry operations (ignore H atoms attached to methyl groups).



$C(CFCIME)_4$



$[Co(NO_2)_6]^{3-}$



2) (8 points) Draw one molecule with  $C_{4v}$  symmetry and another molecule with  $D_{4h}$  symmetry. Sketch all of their symmetry operations.

3. (6 points) Given the set of operations  $\{E, C_4, \sigma_h\}$ , determine the other operations that must be present to form a complete point group. [Hint: Consider all of the products of the given elements with themselves and each other.] b) (2 points) Identify the point group for the complete set of operations. c) (1 point) What is the order of the point group?

4. a) (10 points) Using the twelve Cartesian coordinates for ammonia ( $NH_3$ ) as the basis for a reducible representation, predict the number of normal vibrational modes and their symmetries. b) (6 points) Which of these modes are assignable to N-H stretching or H-N-H bending vibrations? [Hint: use internal vectors to determine this.] Show your work.

5)  $XeF_5^-$  could exist in three possible geometries: a) (8 points) trigonal bipyramidal, b) (8 points) square pyramidal, and c) (8 points) pentagonal planar. Considering **only** the Xe-F vectors, perform a vibrational analysis of  $XeF_5^-$  for all three geometries. Show your work. d) (2 points) Given the following data, which geometry is observed experimentally?

IR ( $cm^{-1}$ )	Raman ( $cm^{-1}$ )
465	502
	423

e) (2 points) Determine the Lewis dot structure of  $XeF_5^-$  and predict its structure using VSEPR.