CHEM442-001
College of Charleston
Spring 1999
Exam III

1(20). In class we studied the quantum mechanical solutions to the H_2 and H_2^+ problems. For the H_2^- molecule ion

A) write the complete (no summation signs) hamiltonian (energy) operator for the internal energy of this system.

B) write the molecular orbital trial wave function using hydrogen atomic ψ_{1s} wave functions as the basis functions.

C) write the complete molecular orbital electron configuration ($\sigma(1s)^{2}$...) assuming that the molecular orbitals are similar to those for H_2 and H_2^+.

D) predict the bond order and magnetic properties based on your answer to (C).

2(15). Assuming no hybridization, write the complete molecular orbital electron configuration for C_2. Describe the bonding and magnetic properties.

Prepare a "puff-ball" sketch of the molecule showing the bonding orbitals, lone pairs, etc.

Will C_2^- be more or will it be less stable than C_2? _____

Will the bond length in C_2^- be longer or will it be shorter than in C_2? _____

3(25). Each of the following four molecules are important in describing ozone depletion by freons. For each molecule, draw the Lewis structure(s), determine hybridization (assume all atoms are hybridized), and draw a "puff-ball" sketch of the molecule.

A) CCl_2F_2

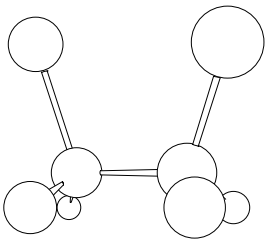
B) O_3

B) NO_2

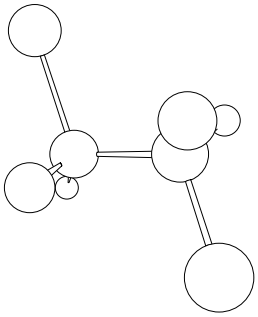
D) $ClONO_2$

4(15). For each of the three configurations of 1,2-dichloroethane, determine the symmetry elements present and identify the respective point group.

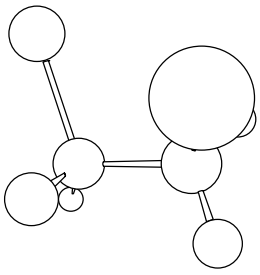
Cl-C-C-Cl dihedral angle = 0°



Cl-C-C-Cl dihedral angle = 180°

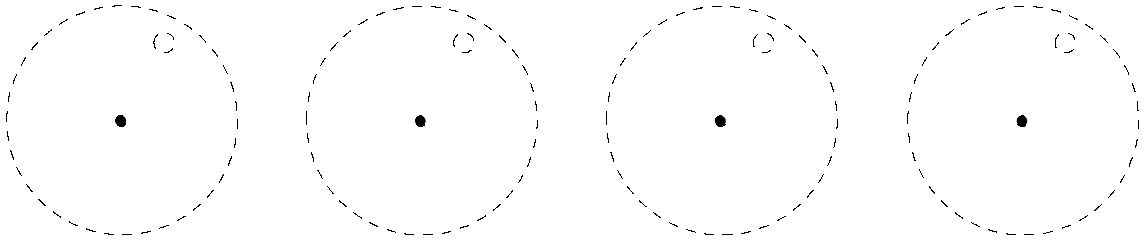


Cl-C-C-Cl dihedral angle = 60°

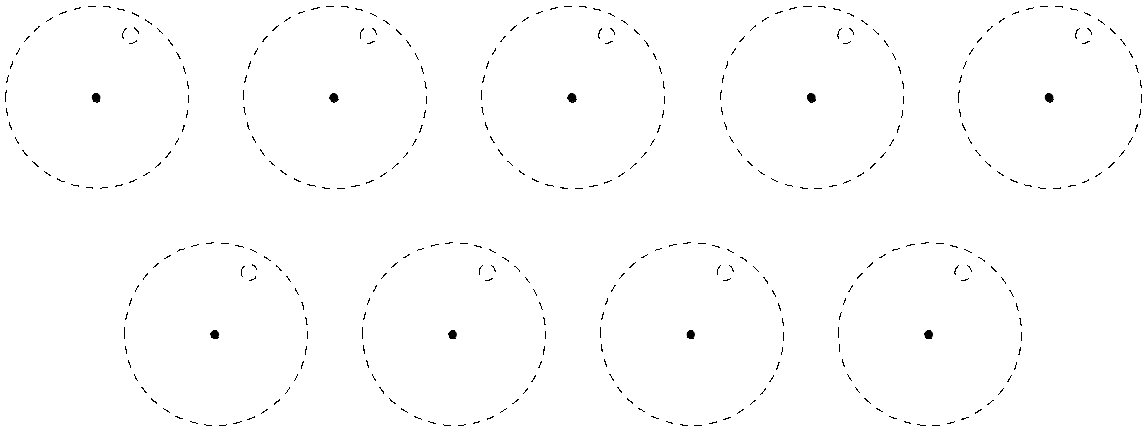


5(25). Identify the two symmetry elements and four distinct operations in the $\mathbf{S_4}$ point group.

Prepare orthographic projections representing these operations. Use solid and dashed circles for particles above the plane of the paper and solid and dashed ×'s for below the paper.



Prepare orthographic projections for the 9 entries in the multiplication table $\hat{A} \times \hat{B}$ where $\hat{A}$ and $\hat{B}$ are not the identity operation.



Prepare the multiplication table.

	$= \hat{B}$
$\hat{A} =$	