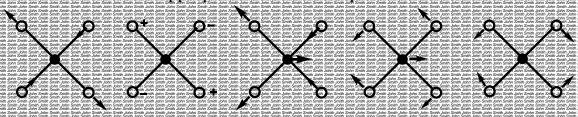
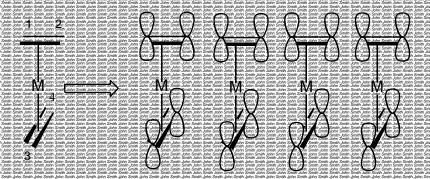
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- (20 pts) Below are vibrations and orbitals of molecules that transform
 according to irreducible representations of their given point groups. Note
 no derivations are needed to answer this problem.
 - a. (10 pts) Five bending modes of XeF₄² are shown below. Assign the modes to their appropriate irreducible representations.



b. (10 pts) Olefins can bind to metal centers. Consider the simplets
 homoleptic complex, the bis(ethylene) complex. Ethylene binds to a
 metal through its pπ-orbitals. The four orbital symmetries appropriate
 for ligand binding to the metal are A₁, B₂ and E. Below are shown the
 p-orbital contours for four orbitals. Color the p-orbitals to give the
 proper orbital symmetries. Label each of the completed diagrams with
 its irreducible representation



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- 3. (20 pts) Short answers. Point values are assigned in parenthesis on each line.
 - a. (9 pts) Identify the point group and list the generators for the letter S

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c. (6 pts) A molecule cannot be optically active if it has any $S_{\bf r}$ axes. Identify the optically active molecules below.

4. (40 pts) H₁ was discovered only 12 years ago by Professor Takeshi Oka of the University of Chicago. The discovery has been profound as this molecule has been observed now at the galactic core. As professor Oka discussed yesterday at MIT, the presence of this molecule in the universe provides an important mechanism for star formation. Construct an energy level diagram for the two molecules using the Hückel approximation to determine the energies. Draw a correlation diagram that relates the Hückel energy levels of the two fragments.

To shorten the time of this problem, consider using the D_{2h} point group for the linear isomer of H_3 . Also, we provide one SALC for linear H_3^{\pm} and two SALCs for cyclic H_3^{\pm} . You need only show work for the missing SALCs.

