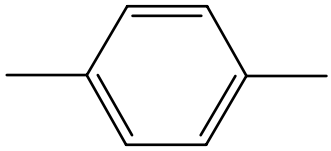
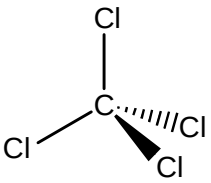
Quiz 2
CHEM 325
Spring 2009

Name: _____

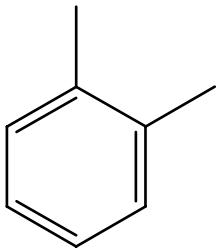
1. (9 Points) Assign the following molecules to the proper point group.



D_{2h}



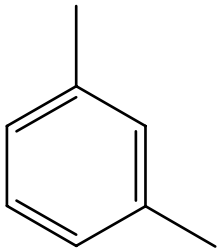
T_d



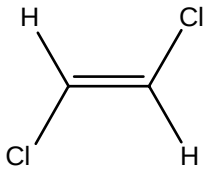
C_{2v}

H-F

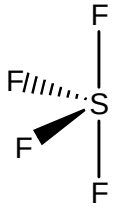
$C_{\infty v}$



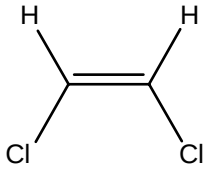
C_{2v}



C_{2h}



C_{2v}



C_{2v}

2. (2 Points) Molecules belonging to the point groups D_{2h} and C_{3h} cannot be chiral. What symmetry element rules out the existence of enantiomers? No explanation is necessary, simply state the answer.

The presence of a mirror plane (indicated by the "h" in the subscript) means that molecules belonging to these point groups can't be chiral and therefore can't have enantiomers. *Remember that a mirror plane is a special king of improper rotation axis (S_1).*

3a. (3 Points) Given the character table for the point group C_{4v} shown below, what irreducible representation results from the direct product B_2 x A_2? Show your work, or at least some justification of your answer, for full credit.

C_{4v}	E	2 C_4	C_2	2 σ_v	2 σ_d		
A_1	1	1	1	1	1	z	x^2+y^2, z^2
A_2	1	1	1	-1	-1	R_z	
B_1	1	-1	1	1	-1		x^2-y^2
B_2	1	-1	1	-1	1		xy
E	2	0	-2	0	0	(x, y) (R_x, R_y)	(xz, yz)

C_{4v}	**E**	**2 C_4**	**C_2**	**2 σ_v**	**2 σ_d**
A_2	**1**	**1**	**1**	**-1**	**-1**
B_2	**1**	**-1**	**1**	**-1**	**1**
B_2 x A_2	**1**	**-1**	**1**	**1**	**-1**

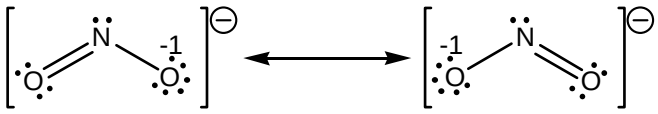
By inspection B_2 x A_2 = B_1.

b. (3 Points) Explain why the four $\hat{\sigma}$ present in the C_{4v} point group are listed as they are in the character table.

They belong to two different classes. Two of the reflections perform geometrically identical operations and the other two do likewise, but each pair of reflections performs an operation that is geometrically different than the other pair.

4. (9 Points) Draw the Lewis dot structure of NO_2^- (showing any resonance structures and non-zero formal charges, if present). To what point group does this ion belong? You are given that the electronic configuration of N is [He] $2s^2$ $2p^3$ and that of O is [He] $2s^2 2p^4$.

NO_2^- has 18 valence electrons, leading to the resonance structures shown below.



The electron pair geometry about the nitrogen is trigonal planar, which leads to a bent geometry (according to VSEPR theory).

The point group is C_{2v}.