

CHEM442-001/002
College of Charleston
Spring 2000
Exam IV

1(50). For each of the following covalently bonded species write the Lewis structure(s); draw a three-dimensional sketch showing the bonding; identify the shape of the species; determine the point group; and determine whether or not the species has a center of inversion, is polar, and is optically active. (You might consider showing your work in case you're interested in partial credit for incorrect final answers.)

A) HClO

Lewis structure:	sketch:	shape _____ point group _____ i _____ polar _____ optically active _____
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B) CCl₃Br

Lewis structure:	sketch:	shape _____ point group _____ i _____ polar _____ optically active _____
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C) OCN⁻

Lewis structure:	sketch:	shape _____ point group _____ i _____ polar _____ optically active _____
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D) Co(H₂O)²⁺

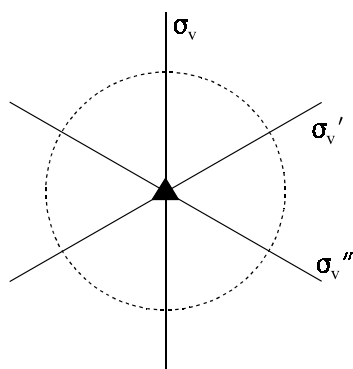
Lewis structure:	sketch:	(excluding H atoms) shape _____ point group _____ i _____ polar _____ optically active _____
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E) BO₂

Lewis structure:	sketch:	shape _____ point group _____ i _____ polar _____ optically active _____
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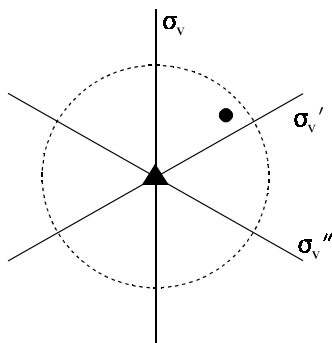
2(50). The point group of chloroform CHCl_3 (maybe you're ready for some?) is C_{3v} . Valuable information for the point group is

C_{3v} representation	\hat{E}	$2\hat{C}_3$	$3\hat{\sigma}_v$	
A_1	1	1	1	z, x^2+y^2, z^2
A_2	1	1	-1	R_z
E	2	-1	0	$(x,y), (R_x,R_y), (x^2-y^2,xy), (xz,yz)$

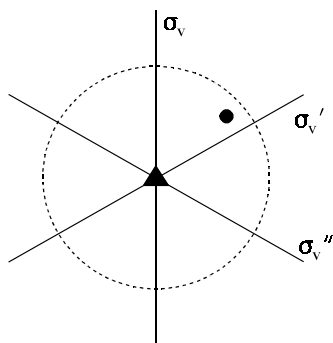


A(15). Show on the projection diagrams the following “multiplications” and identify the result.

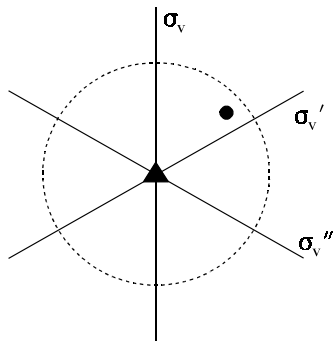
$$\hat{\sigma}_v \times \hat{C}_3 =$$



$$\hat{\sigma}_v' \times \hat{C}_3 =$$



$$\hat{\sigma}_v' \times \hat{\sigma}_v =$$



B(5). How many vibrational degrees of freedom does CHCl_3 have? _____

C(20). Determine the symmetry of the vibrational modes of CHCl_3 expressed as a direct sum of the irreducible representations.

D(5). Which of these are infrared active? _____
 How many peaks will be observed? _____

E(5). Which of these are Raman active? _____
 How many peaks will be observed? _____