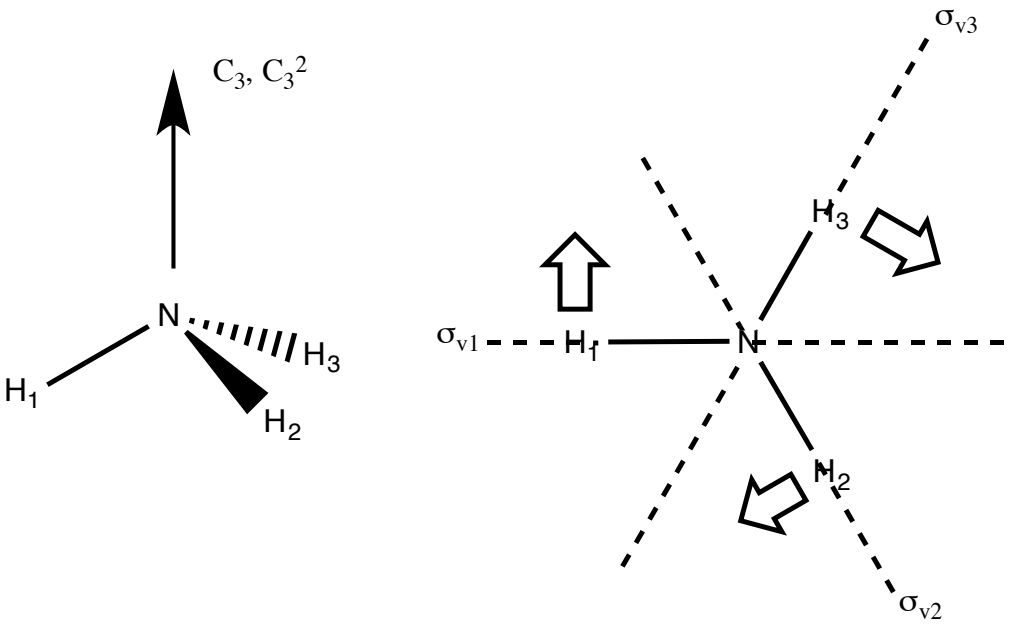
CH431: Additional questions for symmetry elements and operations:

For the molecules below

a. Draw the Lewis structure and indicate the geometry in your drawing
b. Identify the symmetry operations contained in the molecule.
c. Draw each symmetry element in your molecule and show the effect of each operation on the location and orientation of each of the atoms in your molecule

1) $SOCl_2$
2) NH_3

Fill out the following multiplication table for the operations contained in NH_3: E, C_3, C_3^2, σ_{v1}, σ_{v2}, and σ_{v3} (see depictions below). Arrows have been added to the structure to help you think about the orientation of each of the H atoms. Think of each arrow as being perpendicular to an N-H bond. Hint: start by determining the outcomes of applying single operations, then combine two together.



mirror planes pointing out of the page

	E	**C_3**	**C_3^2**	**σ_{v1}**	**σ_{v2}**	**σ_{v3}**
E	E	C_3	C_3^2	σ_{v1}	σ_{v2}	σ_{v3}
C_3	C_3					
C_3^2	C_3^2					
σ_{v1}	σ_{v1}					
σ_{v2}	σ_{v2}					
σ_{v3}	σ_{v3}					

What is the inverse for each operation?

CH_4 contains the following symmetry elements:
E, C_3 axes, C_2 axes, S_4 axes, σ_d planes

1) Illustrate where each of these symmetry elements are in the molecule and show how they affect the atom locations. You should show one example for each symmetry operation
2) How many C_3 axes, C_2 axes, S_4 axes, and σ_d planes does methane contain?