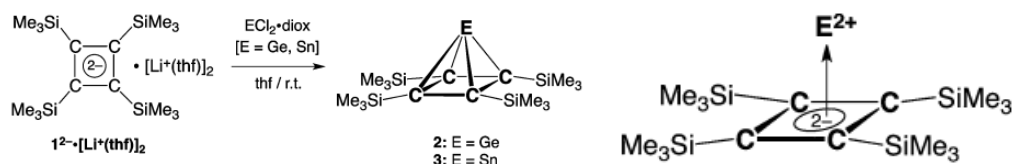


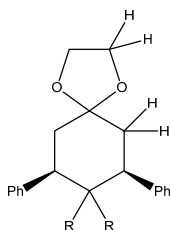
<b>HW 3</b>	<b>Multinuclear NMR</b>	<b>Name:</b>	
<b>Points:</b>	<b>C6800</b>	<b>Date:</b>	
Max. 100 points	<b>Spring 2015</b>	<b>Version A</b>	

1. (13 pts) The  $^{119}\text{Sn}$  NMR resonance of the Sn atom at the apex of the square pyramid in **3** was found to be extraordinarily shielded, being observed at  $-2441.5$  ppm. The value closely approaches those of the stannocene derivatives, with their record high-field tin resonances appearing in the range from  $-2100$  to  $-2300$  ppm. Explain these observations considering the two resonance structures of pyramidane **3**, covalent and ionic.

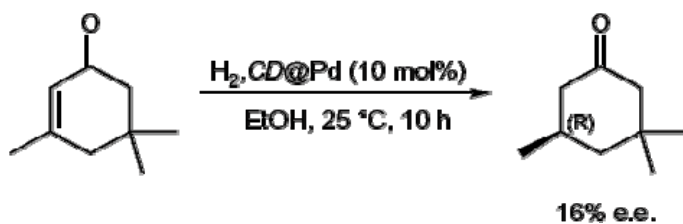


2. (38 pts) Draw all possible complexes  $[\text{PF}_x(\text{CN})_{6-x}]$  and predict multiplicities of signals in  $^{31}\text{P}$  and  $^{19}\text{F}$  NMR spectra.

3. (10 pts) Mark protons of CH<sub>2</sub> in the following molecule as homotopic (H), enantiotopic (E) and diastereotopic (D). Find the symmetry point group of this molecule:



4. (15 pts) How could you establish by <sup>1</sup>H NMR spectroscopy that the following reaction took place? Give at least three pieces of evidence.



5. (24 pts) Calculate relative populations of Te isotopomers of this cation. (Disregard the Se isotopomers, use  $\sigma = 2$ , for the two-fold axis that interchanges the Te atoms)

