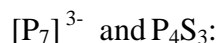


Inorganic Cumulative Exam

Prof. B. K. Teo, April 7, 2005

Total 6 Qs, 115 points.

1. (30%) Count electrons, predict the structures, and give the point-group symmetries of



(a) Skeletal electron pairs.

(b) Structures.

(c) Point group symmetries.

2. (27%) Give the structures, the number of skeletal electron pairs, and the point-group symmetries of each of the following clusters and show how they are related and/or can be interconverted:

(a) trigonal bipyramid, square pyramid, arachno-pentagonal bipyramid.

(b) B_9H_{11} , B_8H_{12} , B_7H_{13} .

(c) $Os_7(CO)_{21}$, $[Os_8(CO)_{22}]^{2-}$, $[Os_{10}C(CO)_{24}]^{2-}$.

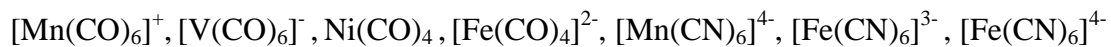
3. (10%) H_2SO_3 is known to exist in two isomers. What would the structures and the pK_a values be for the corresponding H_2SO_3 ?

4. (20%) Using ligand field theory, explain why:

(a) $[NiCl_4]^{2-}$ is paramagnetic while $[Ni(CN)_4]^{2-}$ is diamagnetic.

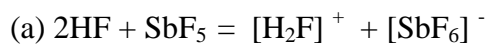
(b) $NiCl_2(PPh_3)_2$ is paramagnetic while $PdCl_2(PPh_3)_2$ is diamagnetic.

5. (8%) For the following list of compounds, indicate:



- (a) The highest CO stretching frequency.
- (b) The lowest CO stretching frequency.
- (c) The highest CN stretching frequency.
- (d) The lowest CN stretching frequency.

6. (20%) Extremely potent acids, capable of protonating even hydrocarbons, are called *superacids*. Examples are mixtures of the following:



Draw the structures of all the products and identify the superacids.