

CHE 514, Descriptive Inorganic Chemistry
Spring, 2005
Readings and Problem Set 4

Group 13

Mackay Chap. 17, pp 427-445 and Chap. 18, pp 516-518. Some of the questions require additional resources.

Supplemental reading for Boron: Skim Greenwood, Chap 6 pp. 139-215. The long discussion of boranes, carboranes and metallocarboranes will give you an idea of the breadth of this area, but don't expect to remember it all!

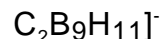
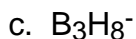
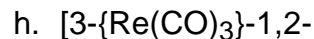
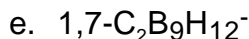
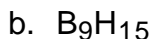
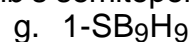
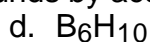
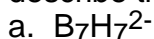
Supplemental reading for Al-Tl: Greenwood Chapter 7 pp 216-267: skim long discussions of Al oxides (pp 242-252).

If you're interested, these books are on reserve: A. G. Massey, Main Group Chemistry, pp 86-95

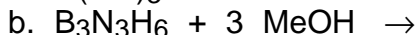
R. H. Crabtree, The Organometallic Chemistry of the Transition Metals, pp 368-382 extends Wade's Rules to transition metal clusters

Problems

1. (32) Sketch the structures of these boron compounds. Classify each as *closo*, *nido* or *arachno* and tell which polyhedron is the basis of each shape. [If you're interested, try to describe the simpler compounds by according to Lipscomb's semitopological model.



2. (10) What are the products of these reactions?



3. (10) Describe and sketch (idealized) three-dimensional structures of MgB_2 and ScB_{12} , emphasizing the arrangement of the boron building blocks.

4. (10) Describe the solution composition of aqueous Al^{3+} as the pH is gradually raised from below 2 to above 12.

5. (15) What is spinel? Describe the coordination environments around the Mg^{2+} and Al^{3+} ions in spinel, and explain why the ions are arranged in these environments. Use this structure to explain the magnetic behavior of Fe_3O_4 .

6. (10) Show how the compounds with empirical formula Me_2ENMe_2 with $E = B$ and Al differ from one another. Why are they so different?

7. (15) a. Explain why thallium forms TIX and TIX_3 for all four halides (F, Cl, Br and I), whereas this is not true of the other group 13 elements. b. Comment on the existence of TII_3 . [Hint: are there three I^- anions?] c. Explain the curious thermal behavior of TIX_3 : TIF_3 is stable to about $500^\circ C$; $TICl_3$ loses Cl_2 at about $40^\circ C$ to give an insoluble white salt; $TIBr_3$ loses bromine just above room temperature to give first " $TIBr_2$ ", then an insoluble pale yellow solid.