

NAME:

Chemistry 514
Spring 1995
Examination 2
April 19, 1995

Problem	Points	Score
1	30	
2	5	
3	25	
WORK ONLY 4 OF PROBLEMS 4-8 FOR 10 POINTS EACH. CROSS OUT THE NUMBER OF THE PROBLEM WHICH YOU DON'T WANT GRADED.		
4	10	
5	10	
6	10	
7	10	
8	10	
Total	100	

1. (30 points: 3 for each choice, 2 for each reason) For each of the following groups, **circle** the item which is best described by the accompanying phrase, and briefly **explain** your reason. Sometimes the best explanation is to tell what is wrong with the other choices.

a. Structural unit in principal allotropes of elemental boron

B_{12} icosahedron

B_6 octahedra

B_4 tetrahedra

b. Weakest of these Lewis acids

BF_3

BCl_3

BBr_3

BI_3

c. More likely to be a solid at room temperature [Give a chemical reason. Zero points for "higher melting point".]

$SnCl_2$

$SnCl_4$

d. *p*-type semiconductor

Ge doped with Ga

Ge doped with As

Pure Si

Pure As

e. Element which is made commercially by electrolytic reduction

B

Si

Al

C

f. Material whose principal applications are NOT based on physical hardness

SiC

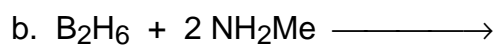
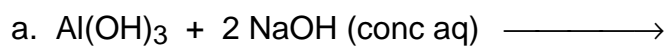
BN (cubic)

Ge

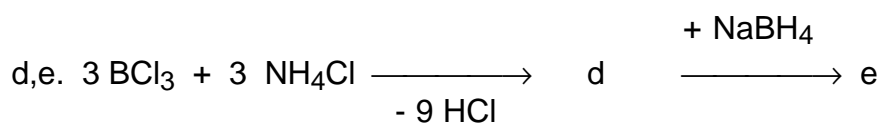
Al₂O₃

2. (5) Fill in the five missing atomic symbols on the periodic table on the next page.

3. (35) Sketch the principal product of each of these reactions.



c. $\text{C}_{60} + \text{excess Rb (vapor)} \longrightarrow$ [Give the formula of the most important product. A detailed structure is not necessary in this case.]



WORK ANY 4 OF PROBLEMS 4–8 FOR 10 POINTS EACH. ON THE COVER SHEET, CROSS OUT THE NUMBERS OF THE PROBLEM WHICH YOU DON'T WANT GRADED.

4. (10) Each of the p-block elements devises its own way of coping with being sub-valent. Describe the nature of each of the following compounds. Is it stable? What structure does it adopt in a condensed phase (solid or liquid)? Exact bond distances and angles are not necessary, but make the overall coordination geometry of the central atom(s) clear. There may not be a unique structure for some of these empirical formulas – any correct one will do. How does each structure reflect the overall chemistry of the element?

- (a) BCl
- (b) GaCl₂
- (c) SiF₂
- (d) PbCl₂

5. (10) Describe these boron compounds as closo, nido or arachno. Show your reasoning (i.e., electron count). Sketch each structure, and indicate the parent polyhedron from which the structure is derived.

- (a) B₄H₁₀
- (b) 1,5-C₂B₃H₅

6. (10) The chemistry of Lewis base adducts of AlH₃ has developed rapidly in the last few years.

- (a) How is base-free AlH₃ prepared, and why is it not very well characterized?
- (b) Describe the preparation of a specific Lewis base adduct of AlH₃.
- (c) Describe and sketch the structure of the adduct in (b). Exact bond distances and angles are not necessary, but make the overall coordination geometry of the Al atom(s) clear.

7. (10) Starting with elemental silicon and any other common reagents, show the essential steps in the preparation of poly(dimethylsilicone). Give a typical application of this polymer.

8. (10) Below is a picture of Concrete (by Paul Chadwick, Dark Horse Comics). If Concrete is really made of concrete, discuss his overall composition. Include at least a listing of the three essential ingredients of Portland cement, and describe the essential structural units of hardened cement.