

CHE 514, Descriptive Inorganic Chemistry
Spring, 2005
Readings and Problem Set 3

Hydrogen, Alkali metals, Alkaline earths

Readings: MacKay Chaps. 9, 10

Optional: Greenwood, Chap 4 pp. 68-106; **just skim** extensive discussion of ionic bonding (pp 79-81); Chapter 5 pp 107-138: **just skim** long discussions of lime (pp 120-121) and Grignard applications (pp 134-135)

Problems:

1. (10) MacKay 9.2
2. (10) MacKay 10.2 (ignore "and (b) the values for")
3. (10) Compare hydrogen bonds (protonic bridges) with the hydride bridges found in electron-deficient compounds. Be sure to contrast the geometries, number of nuclear centers, number of electrons, and give a specific example of each.
4. (5) Show the nuclear-spin microstates that comprise *ortho*- and *para*-hydrogen.
5. *(10) Should nuclear-spin isomers of pure H-D exist? List the possible microstates. How they might divide up into states like *ortho* and *para*? (A qualitative answer is fine – no need for a complete quantum mechanical description.)
6. (24) Write chemical equations for these reactions. (Some common trivial names are used intentionally.)
 - a. Tungsten (VI) oxide and hydrogen
 - b. Hydrogen and fluorine
 - c. Magnesium and hot water
 - d. Calcium hydride and water
 - e. Cesium and dry dioxygen
 - f. Lye and carbon dioxide
 - g. Quicklime and sulfur dioxide
 - h. Baking soda upon heating
7. (15) Does each of these elements form an ionic, metallic or covalent hydride, or no stable hydride at all? a. ruthenium; b. palladium; c. silver; d. phosphorus; e. calcium.
8. (5) Why is sodium hydroxide more water-soluble than sodium chloride?
9. (5) Why is it possible to reduce potassium chloride to potassium by using sodium metal?
10. (5) Sketch the structure of Na₂Crypt[2,2,2].
11. (5) Why is calcium nitrate more water-soluble than calcium sulfate?
12. (5) Why is the dissolution of anhydrous magnesium chloride in water more exothermic than the dissolution of magnesium chloride hexahydrate?
13. (10) Why are organometallic compounds of lithium and magnesium more commonly used in organic synthesis than those of potassium and calcium?
14. *(10) Treatment of M(OH)₂ or MO (M = alkaline earth) with a carboxylic acid gives *volatile* carboxylates for M = Be, but *involatile* compounds for the heavier alkaline earths. Explain why the compounds are so different in properties.

***Questions 5 and 14 are optional for undergraduates.**