

NAME:

Chemistry 514
Spring 1993
Examination 1
February 19, 1993

Problem	Points	Score
1	40	
WORK ONLY 3 OF PROBLEMS 2-5 FOR 10 POINTS EACH. CROSS OUT THE NUMBER OF THE PROBLEM WHICH YOU DON'T WANT GRADED.		
2	10	
3	10	
4	10	
5	10	
WORK ONLY 2 OF PROBLEMS 6-8 FOR 15 POINTS EACH. CROSS OUT THE NUMBER OF THE PROBLEM WHICH YOU DON'T WANT GRADED.		
6	15	
7	15	
8	15	
Total	100	

1. (40 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. Largest atomic radius

Na

Al

P

Cl

b. Most soluble in benzene

LiI

NaCl

MgF₂

c. Reacts with carboxylic acids to give volatile, molecular carboxylates

BeO

Rb₂O

BaO

d. Ionic hydride

CaH₂

PdH_{0.6}

SH₂

e. Crown ether with a preference for Li^+ ion

14-crown-4

15-crown-5

16-crown-6

f. Forms strongest hydrogen bonds with another molecule of itself

HF

B_2H_6

H_2S

g. Principal component of the earth's core

Fe/Ni

Aluminosilicate rocks

Metallic hydrogen

h. Most likely to absorb water from air to form a hexahydrate, $[\text{M}(\text{H}_2\text{O})_6]^{2+} \text{SO}_4^{2-}$

BeSO_4

MgSO_4

BaSO_4

Short answers: two or three sentences for discussion questions.

WORK ONLY 3 OF PROBLEMS 2–5 FOR 10 POINTS EACH. ON THE COVER SHEET, CROSS OUT THE NUMBER OF THE PROBLEM WHICH YOU DON'T WANT GRADED.

2. (10) Write out the names and symbols of the first ten elements in the periodic table (atomic numbers 1 to 10).
3. (10) Why is there a profusion of elements from ^{48}Ti to ^{64}Cu , with a peak at ^{56}Fe , in many large stars (1.4 to 3.5 times larger than our sun)?
4. (10) Why does the structure of the periodic table depend upon the atomic numbers, not the atomic weights, of the elements?
5. (10) (a) Describe two common preparations (laboratory or industrial) of hydrogen gas, by using balanced chemical equations. (b) What is the principal industrial use of hydrogen?

Longer discussion questions: several sentences and/or appropriate structures or equations.

WORK ONLY 2 OF PROBLEMS 6–8 FOR 15 POINTS EACH. ON THE COVER SHEET, CROSS OUT THE NUMBER OF THE PROBLEM WHICH YOU DON'T WANT GRADED.

6. (15) (a) Describe the structure (solid and hydrocarbon solution) of LiCH_3 . Include a sketch. (b) Qualitatively describe the intra- and inter-molecular rearrangements which LiCH_3 undergoes in hydrocarbon solution.
7. (15) The heavier alkaline earth elements Sr and Ba dissolve in liquid ammonia to give blue solutions, but Be and Mg do not dissolve in ammonia. (a) Suggest a *reason* for this difference in behavior. (b) What chemical species are likely to be present in the ammonia solutions of Sr and Ba? (c) Are Sr and Ba to be *more* or *less* likely than the alkali metals to form "alkalides", i.e., solvated metal anions?
8. (15) (a) What is the difference between the *ortho* and *para* forms of hydrogen? (b) Which form is favored at low temperature (near 0 K)? (c) Describe one physical property which is significantly different for the *ortho* and *para* forms of hydrogen.