Chemistry 448/548 Name: _____
Test 1
Fall 2003

Very Short Answer Questions: (3 points each)

1. The electron configuration of Pb^{2+} is _____.

2. What is the border condition for the particle-in-a-box? _____

3. The _____ quantum number represents the shape of the orbital.

4. Orbitals within the same subshell shield each other _____.

5. Ionization energy is always _____.

6. *S* orbitals have _____ angular dependence.

7. A _____ is a collection of operations that describes the symmetry of an object.

8. The T_d point group has how many C_3 axes? _____

9. A reaction that yields a thermodynamically less stable product is said to be _____ controlled.

10. Which of the elements assigned for this test unexpectedly forms covalent bonds preferentially? _____

Discussion Questions: (You must show work to receive credit!)

1. Briefly discuss the origin of chemical explosions. (5 points)

2. Two different conditions give rise to atomic orbital nodes. What are they? What is the physical significance of a node? (10 points)

3. How can 3 of the following 4 be isolated from their naturally occurring sources: Al, He, Mg, Na? (9 points)

4. The book notes that the alkali metals have favorable electron affinities. In other words, it is energetically favorable for an alkali metal atom to add an electron. (10 points)

   a) Why?

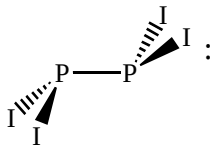
   b) Of course, in practice alkali metals always lose an electron when forming salts. If gaining electrons is favorable, then why do alkali metals always lose electrons when forming compounds?

5. Effective nuclear charge (Z_{eff}) of the 2*s* orbital increases across the second period according to the table below. Comment on the uniformity of the increase and deviation(s) from uniformity. Is the dramatic increase in Z_{eff} that occurs on dropping to the third period expected or not? Why or why not?

Element	Li	Be	B	C	N	O	F	Ne	Na
Zeff (2*s*)	1.28	1.91	2.58	3.22	3.85	4.49	5.13	5.76	6.57

6. Give point groups for each of the following (no work required): (16 points)

BCl_3:



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$Cl_2C=C=CCl_2$:

S_8:

7. Consider the molecule IF_3. What are the possible vibrational modes for this molecule? How many bands would one find in the infrared spectrum? In the Raman spectrum? (10 points)

	E	C_2	σ_v	σ_v'		
A_1	1	1	1	1	z	x^2, y^2, z^2
A_2	1	1	-1	-1	R_z	xy
B_1	1	-1	1	-1	x, R_y	xz
B_2	1	-1	-1	1	y, R_x	yz