Chemistry 448 Test 1 Name:_____
Fall 2025

Very Short Answer Questions: (3 points each)

1. What is the electron configuration of Te^{4+}? _____

2. The size of atoms _____moving right across the periodic table.

3. The probability of finding an electron at a given point equals _____.

4. Ionization energy (define) -

5. The first ionization energy of phosphorus is somewhat _____than expected when compared with where it is expected to be found.

6. The angular wave function is independent of _____.

7. The absence of a(n) _____defines a molecule as being chiral (dissymmetric).

8. Is it possible for a molecule belonging to a dihedral point group (e.g. D_n, D_{nh}, or D_{nd}) to exhibit a dipole moment? _____

9. For BF_3, what symmetry element is obtained if the following multiplication is performed: $C_2 \otimes C_3$? _____ (Your answer should be neither C_2 nor C_3.)

10. _____is the one element from Groups I-IIIA that is a semiconductor when pure.

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

1. Why is quantization a consequence of the Schrödinger equation? (Answer with respect to the particle-in-a-box problem.) (10 points)

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

3. Which of the following is more stable and why? (10 points)

   (a) Co^{2+} or V^{2+}

   (b) Ta^{2+} or V^{2+}

4. There are two types of nodes. What are they and what physical significance do they have if any? (i.e. Would we notice a difference in atoms if all nodes were removed? What would the difference(s) be?) (10 points)

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

   B_2H_6: C_6H_{12} (Chair conformation):

   the letter "W": *cis*-$Cr(CO)_4(PH_3)_2$:

6. As you know the H^+ ion is easily generated in aqueous solution. In spite of this, the ionization energy of a hydrogen atom is not only the largest of the Group IA elements, it is largest by much more than is initially expected. Why? (5 points)

7. Using the character table below, generate the reducible representation for CH_4. (Hint: $\Gamma(C_3) = 0$) How many total vibrations occur in a methane molecule and what are they? What are the C-H stretches? (10 points)

	E	**8C$_3$**	**3C$_2$**	**6S$_4$**	**6σ_v**
A_1	1	1	1	1	1
A_2	1	1	1	-1	-1
E	2	-1	2	0	0
T_1	3	0	-1	1	-1
T_2	3	0	-1	-1	1
Γ(total)		0			
Γ(C-H)					