Chapter 7: Quantum Theory & Electronic Structure of Atoms Worksheet #2

1. Calculate the energy required to excited the electron in Be^{3+} from principal energy level n = 3 to level n = 7. Also calculate the wavelength of light that must be absorbed by a hydrogen atom in its ground state to reach this excited state.

2. Give the values of n, ℓ, and m_ℓ for every orbital with n = 6.

3. Indicate whether the set of quantum numbers (n, ℓ, m_ℓ) below exits or not.

a.	1, 1, 0	_____	e.	8, 1, 0	_____
b.	5, 4, –3	_____	f.	–2, 1, +1	_____
c.	3, 2, –3	_____	g.	4, 2, –1	_____
d.	6, 7, +7	_____	h.	7, 3, +4	_____

4. What is the maximum number of electrons in an atom that can have these quantum numbers?

   a) $n = 4$

   b) $n = 5, m_\ell = +1$

   c) $n = 2, \ell = 1$

   d) $n = 3, \ell = 2$

   e) $n = 5, m_s = +½$

5. Draw the shapes (including the orientation) of all the *s*, *p* and *d* orbitals.

6. Which orbital in each of the following pairs is higher in energy?

   a. 5*p* or 5*d*

   b. 4*s* or 3*p*

   c. 6*s* or 4*d*

7. What is the atomic number and the electron configuration of the yet undiscovered element directly below Fr in the periodic table?

8. Using the Aufbau principle, write the **complete** expected electron configurations and the orbital box diagrams for partially filled orbitals following the Pauli exclusion principle and Hund's rule for each of the following atoms:

   a) S

   b) Fe

   c) N

   d) Cr

   e) Cu

9. On the basis of their position on the periodic table, select the atom with the larger atomic radius in each of the following pairs:

a.	Na, Cs	e.	Ne, Xe
b.	Be, Ba	f.	Na, P
c.	N, Sb	g.	K, Ge
d.	F, Br	h.	Al, Cl

10. List the ions in order of increasing ionic radius:

    N^{3-}, Na^{+}, F^{-}, Mg^{2+}, O^{2-}

11. Explain why it is unusual for I_1 of S to be **lower** then I_1 of P. Give a possible explanation.

12. Calculate I_{80} (the 80^{th} ionization energy) of Hg using the Bohr equation.

13. Arrange the elements in order of increasing negative value of EA:

    a. Li, Na, K

    b. F, Cl, Br, I

14. Identify each ion:

    a. 3+ ion: $1s^2 2s^2 2p^6$

    b. 3+ ion: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3$

    c. 2+ ion: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10}$

    d. 1+ ion: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 4d^{10}$

15. Which of the following are isoelectronic with each other?

    C, Cl^-, Mn^{2+}, B^-, Ar, Zn, Fe^{3+}, Ge^{2+}