Name: _____   Date: _____

[3 pt]   1. Define the Pauli exclusion principle. Explain the rational behind the Pauli exclusion principle (ie why it makes sense).

[3 pt]   2. What 3 concepts determine the relative energy levels of different orbitals?

[3 pt]   3. Define Coulombs Law. Define each variable and provide values for any constants.

[4 pt]   4. Complete the following statements about Coulombs Law.

     (a) Like charges _____. and have a _____. energy.

     (b) Opposite charges _____and have a _____. energy.

     (c) The magnitude of the interaction is _____.to the distance between the charges.

     (d) The magnitude of the interaction is _____.to the magnitude of the charges.

[3 pt]   5. Define the term "Shielding", include a sketch illustrating your definition. How does this effect the energy of the electron being shielded?

[3 pt]   6. Define the term "Penetration", include a sketch illustrating your definition. How does this effect the energy of the electron experiencing penetration?

[4 pt]   7. List the orbitals from lowest to highest energy. Go up to the 7s orbital. Include a sketch up to the 5s orbital.

[3 pt]   8. What are the three Aufbau Principles.

[2 pt]   9. Explain the rational behind Hund's rule (ie why it makes sense).

[3 pt] 10. What is the meaning of each part of the designation $3d^7$.

[4 pt] 11. Give the quantum address (n, l, m_l, m_s) for the electrons with a principle quantum number of 2. (There are 8 total addresses.)

[5 pt] 12. Which elements have the following electron configuration:

    (a) $1s^2, 2s^2, 2p^6, 3s^2, 3p^4$ 12(a) ——————

    (b) $1s^2, 2s^2, 2p^2$ 12(b) ——————

    (c) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^3$ 12(c) ——————

    (d) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^6, 5s^2, 4d^7$ 12(d) ——————

    (e) [Ar] $4s^2$ 12(e) ——————

[5 pt] 13. Give the electron configuration (using the notation in the previous question) for the following elements:

    (a) B

    (b) Ti

    (c) Cu

    (d) Zr

    (e) I

[5 pt] 14. Draw orbital diagrams for the following elements. Ignore any extra boxes provided.

    (a) N:

    (b) V:

    (c) Na:

    (d) S:

    (e) Br:

[3 pt] 15. The Aufbau principles correctly predicts the electron configuration for 90 elements and incorrectly predicts them for 19 elements. Why?

[2 pt] 16. The Aufbau principles incorrectly predict the outer shell electron configuration of silver as : $[Kr]5s^2 4d^9$. What is the correct outer electron shell configuration? Explain.

The following questions are EXTRA CREDIT. If you can answer these you really understand Quantum Mechanics!

17. If the orbitals in an atom could each hold three electrons instead of two, what would the atomic symbols be for the first 4 Noble gases? (Hint: the first Noble gas would be Li.) Explain.

18. Extend Table on page 319 to show the allowed combinations of quantum numbers when $n = 5$. How many orbitals are in the fifth shell? Call the newest orbital the 5j orbital!

19. Imagine a universe in which the four quantum numbers can have the same possible values as in our universe except that the angular-momentum quantum number l can have integer values of 0, 1, 2, ..., n +1. (Instead of 0, 1, 2, ..., n-1).
    (a) How many elements would be in the first two rows of the periodic table in this universe? Explain.   19(a) ——————

    (b) What would be the atomic number of the element in the second row and fifth column? Explain.   19(b) ——————

    (c) Draw an orbital filling diagram for the element with atomic number 12.   19(c) ——————