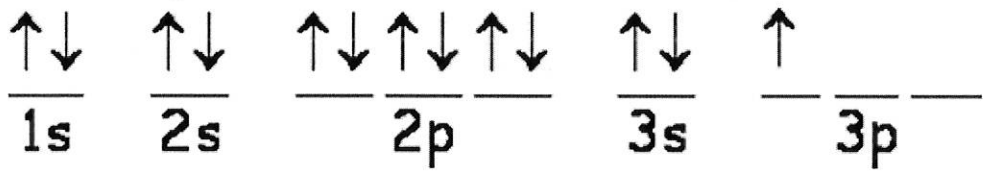
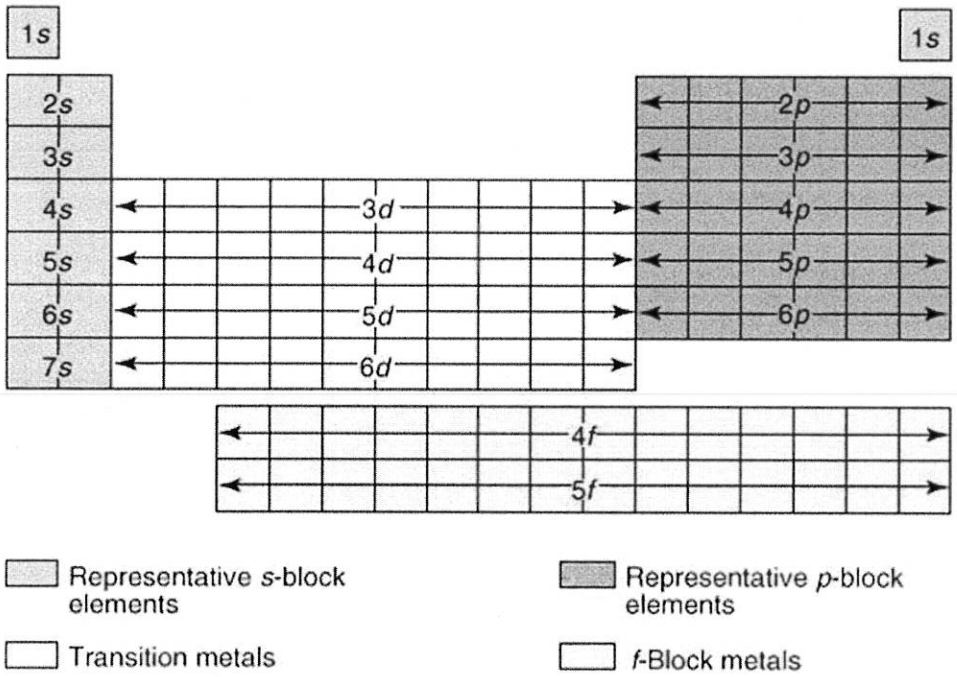
Orbital Notation Configuration for Electrons

1. An orbital notation diagram looks like the one below:



   a. In this diagram:
      i. The numbers 1, 2, 3, … under the blank represent the energy level (remember that energy levels can be determined by the ROW in the periodic chart; for example, sodium is found in the 3rd row of the chart, therefore its highest main energy level is 3)
      ii. The letters s, p, d, and f represent the sublevel (remember that sublevels are represented by the different sections of the period chart; columns 1&2 are the s sublevel; columns 13-18 are the p sublevel; columns 3-12 (the transition metals) are the d sublevel); and the two rows at the bottom of the chart (the lanthanide and actinide series) are the f sublevel)
      iii. Each blank represents an orbital
      iv. Each arrow represent an electron
   b. From this information we can say that electrons are found in oribtals, orbitals are found in sublevels and sublevels are found in main energy levels
2. The advantage of using this notation is that it gives detailed information about every electron in the atom. The disadvantage is that it's tedious to write.
3. A few notes before you start:
   a. Note that H and He are the only two elements in the first row of the periodic chart; therefore, they are both considered in the 1st main energy level; even though He is in the 18th column, it is still in the s sublevel → it is the only element with such an exception
   b. Remember our 3 rules:
      i. Aufbau principle – electrons occupy the lowest energy level possible → this means the electrons will fill each lower main energy level and sublevel before filling the higher ones
      ii. Paul Exclusion Principle – no two electrons can in the same atom have the exact same set of quantum numbers → this means that if there are two electrons in the same energy level, they will have opposite spins. We represent this by drawing one electron as an up arrow and the second electron as a down arrow. **REMEMBER:** there can only be TWO electrons in one sublevel
      iii. Hund's rule – must fill each orbital with one electron before pairing can occur → each line for a sublevel must contain one arrow before you add a second arrow
   c. Drawing orbital notation diagrams is just like reading a book! You must go row by row left to right writing each energy level, sublevel, orbital and electron!
   d. The first main energy level only contains the s sublevel; s sublevel only have 1 orbital
   e. The second main energy level contains s and p sublevels; s sublevel=1 orbital, p sublevel = 3 orbitals
   f. The third main energy level contains s, p, and d sublevels; s sublevel = 1 orbital; p = 3 orbitals; d = 5 orbitals
   g. Fourth main energy level contains s, p, d, and f sublevels; s=1 orbitals, p=3 orbitals, d=5 orbitals, f=7 orbitals
   h. With the d and f sublevels, the main energy level changes even though it is in the same row! See diagram below:



4. To draw the orbital notation or diagram for an element:
    a. Locate the element on the periodic chart
    b. Determine the element's main energy level (row)
    c. Determine the elements sublevel (section)
    d. Determine the number of electrons in the element
5. Example: sodium
    a. Sodium is has an atomic number of 11
    b. It is located on the 3rd row of the chart → 3rd main energy level
    c. It is located in the 1st column, which means it is in the s sublevel
    d. It has 11 electrons
    e. To draw the orbital notation:
        i. Starting from the top of the periodic chart, draw the 1s orbital (1 line labeled 1s), then draw the 2s line (1 line labeled 2 s), then draw the 2p lines (3 lines labels 2p), then draw the 3s line → you have started with hydrogen and worked your way to sodium drawing each main energy level and sublevel in between

        ii. Every sublevel until 3s should be completely filled with electrons (there should be one up arrow and one down arrow for each line drawn) → this gives us a total of 10 electrons so far

        iii. Since sodium only contains 11 electrons, you should only draw one electron in the 3s sublevel. This is the final orbital diagram for sodium:

6. Your turn! Draw the orbital diagrams for the following elements:
    a. Li

b. O

c. Ca

d. Ne

7. Valence electrons are the outermost electrons of an atom. They determine an atom's chemical reactivity. The number of valence electrons in an atom can be determined by the number of electrons in the HIGHEST s and p sublevels of the atom! For example, in sodium, our highest s sublevel is 3s and it contains 1 electron; therefore, an atom of sodium has 1 valence electron
8. Draw the orbital diagrams for the following elements and determine the number of valence electrons for each:

a. F

b. Sc

c. Sr

d. I

e. Hg

f. Cl

g. Zn

h. Si

i. S